Chapter 6

Marine Habitat and Fisheries

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This chapter addresses impacts and mitigation for marine plants and animals. Marine communities are those directly associated with the shoreline and marine environment. Terrestrial plants and animals involve different issues and are discussed in a separate chapter (Chapter 5). The recent listing of Puget Sound chinook salmon under the endangered species act and population declines of other marine species have greatly increased agency concerns regarding shorelines.

6.1 Primary Issues

About one-third of Puget Sound shorelines and half of King County shorelines have been developed. The shoreline at the site has also been developed, but since the dock has not been used for more than 20 years, the area is now quiet and is used by a variety of fish and other marine organisms. Sunken barges and the dock itself now provide habitat for a variety of marine life.

Resumption of barging would reintroduce activity along the shoreline at the project site. These activities would include renovation and maintenance of the existing dock; maneuvering and docking barges and tugs; and loading mined products onto barges from the conveyor. Figures 6-1a through 6-1c show the location of the existing dock and the position of barges along the dock under the Proposed Action in relation to the existing nearshore marine environment.

The primary issues analyzed in this chapter include:

- Would shading from barges at the dock adversely affect eelgrass or other marine biological communities?
- Would accidental spillage of sand and gravel during barge loading adversely affect marine life under or near the dock and barges?
- What would be the potential for petroleum spills from increased marine equipment activity?

- Would stormwater, propeller wash, or barge grounding affect marine organisms?
- Would removing a portion of the bluff during mining change the deposition/erosion dynamics of the beach?
- What effect would the project have on geoduck clam harvest by the Puyallup Tribe?
- Would the noise and vibration from pile driving or barge loading affect salmon and other marine animals, including whales?
- How would dock repairs and/or maintenance impact marine habitats?
- How would artificial light from the project affect marine life?

6.2 Affected Environment

The physical and biological characteristics of the marine environment adjacent to the project site are fairly typical of Puget Sound beaches. Information sources used in this analysis include:

- A marine biology report prepared as part of the Environmental Checklist (Associated Earth Sciences, Inc. 1998);
- an eelgrass survey and general marine reconnaissance survey conducted by Jones & Stokes in July and August 1999 (Jones & Stokes 1999; included as Appendix J);
- a marine assessment conducted under the direction of the Department of Ecology (EVS 2000);
- the Puget Sound Environmental Atlas (Evans-Hamilton, Inc. and D.R. Systems 1987, PSEP 1992);
- publications from the USFWS, National Marine Fisheries Service, WDFW, Washington Department of Health, and other agencies on the status of fish and fisheries;
- personal communication and workshops with staff from the WDNR, WDFW, and King County DNR; and
- scientific literature and other published reports, as cited.

For a comprehensive review of shoreline life in Puget Sound, see Kozloff (1983).

6.2.1 Physical Components

Marine habitat at the site can be divided into three physical zones: intertidal, nearshore subtidal, and offshore (Figure 6-1a).

6.2.1.1 Intertidal Zone

The *intertidal zone* is the area exposed during low tide and submerged at high tide (commonly referred to as the beach). At the site, this zone is sandy, with occasional bands of cobble (stones 2.5 to 10 inches in diameter) running parallel to the beach.

6.2.1.2 Nearshore Subtidal Zone

The *nearshore subtidal zone* is the area between mean lower low water elevation (MLLW) and about -30 feet MLLW. Since water depth fluctuates constantly in this zone, depth is measured based on the average lowest low tide of the day. This point is measured as "0 MLLW." One foot deeper would be –1 MLLW. One foot shallower would be + 1 MLLW.

The nearshore subtidal zone near the dock consists of sand and silt (Figures 6-2a and 6-2b). Starting from the shoreline, the bottom slopes gradually to about the end of the dock, at which point the bottom drops off steeply. A mound of sand and gravel spilled during previous loading operations is present below the old loading point of the dock (the top of the mound measures about -20 feet MLLW) (see Figures 6-1a and 6-1b).

A principal concern for this analysis is the nearshore subtidal zone of approximately -22 feet MLLW or less (Figures 6-2a and 6-2b). This is the depth zone found to support eelgrass in Puget Sound (Phillips 1984). Eelgrass is considered very important because of its use by spawning herring, Dungeness crab, juvenile salmon, and other marine animals. Eelgrass is protected under WAC 220-110, Hydraulic Code Rules.

As Figures 6-2a and 6-2b show, water depths seaward of the dock are mostly deeper than -22 feet MLLW. This is important because this is where most activities associated with barging materials would occur, and because eelgrass and associated communities typically do not occur at depths of 22 feet or greater.

Shoreline armoring (bulkheads and riprap) protect community developments to the north and south of the project area (Figure 11-5). These structures probably affect alongshore sediment transport to and from the site.

Several extensions of the inshore bench occur as submerged ridges oriented perpendicular to the shoreline at regular intervals (Figure 6-3). The dock and associated historical product spill are located on top of one of these ridges. Additional ridges are located north and south of the dock approximately 300 feet apart.

The substrate on these ridges consists of sand coarser than that found inshore, but does not contain cobble, which is found under the end of the conveyor. Eelgrass grows on the ridge north of the dock.

6.2.1.3 Offshore Zone

The third physical zone is the *offshore zone* (generally areas below –30 MLLW). At the site, the substrate within the offshore zone consists of a mix of coarse and silty sands.

Human-made features in the offshore zone include the dock and associated pilings; offshore dolphins; a sunken pleasure boat; and two sunken wooden barges (Figure 6-2b).

Table 6-1 summarizes the physical components of the marine habitat associated with the project site, as well as associated algae, plants, and animals typical of the area.

6.2.2 Biological Components

The marine environment near and around the dock includes areas of bare sand, eelgrass beds, and "reef" habitat associated with the pier and sunken barges. An eelgrass survey and marine reconnaissance survey conducted on July 24th, 1999 and August 1, 1999, identified one aquatic plant (eelgrass), six varieties (taxa) of algae, 22 invertebrate species, and 20 fish species (Jones & Stokes 1999).

Key species of concern, as identified through scoping and public/agency comments on the DEIS, are described below.

6.2.2.1 Eelgrass

Eelgrass at the Site. Several eelgrass patches grow between the dock and the shore (Figures 6-2a and 6-2b) within the nearshore intertidal zone. Based on habitat and light availability, eelgrass could occur anywhere at this site down to a depth of about -22 feet MLLW. However, direct surveys found most eelgrass at the site between -5 feet and -15 feet MLLW (Appendix J). The deepest eelgrass occurred at -15.9 feet MLLW.

Eelgrass at the site is not particularly unique or healthy, when compared to other eelgrass beds in the region. For example, eelgrass at the site grows in isolated patches, ranging in size from 10 by 10 feet to 40 by 60 feet during the 1999 growing season. In contrast, eelgrass grows in larger beds in Quartermaster Harbor and other identified eelgrass areas in Puget Sound. Eelgrass patches north and south of the site cover larger areas and are more continuous in nature. Eelgrass patches at the site may be fragments of larger eelgrass beds disturbed by past mining activity. Within the patches on the site, eelgrass density ranges from single plants to 22.9 turions (stems) per 0.25 square meter. In high-quality beds in Puget Sound, eelgrass grows at densities up to 215 turions per 0.25 square meter (Phillips 1984). Average eelgrass beds are in the range of 40 to 50 turions per 0.25 square meter.

In Quartermaster Harbor, and along the shores southwest of Sandy Shores, eelgrass forms a more continuous band, and eelgrass occurs at densities of approximately 40 turions per 0.25 meter and greater.

Eelgrass Function within the Marine Ecosystem. Eelgrass serves a variety of ecological functions. It provides food for grazers and nutrients to sediments; provides shelter for juvenile fish (including salmon and herring); and stabilizes sediments (Phillips 1984). As such, eelgrass and its associated flora and fauna are an important element of the Puget Sound food web.

For a more complete description of the ecological role of eelgrass, see Phillips (1984).

Local and Regional Context of Eelgrass at the Site. Eelgrass covers about 63 percent of the Maury Island shoreline (10.6 linear miles) and 56 percent of the combined Vashon/Maury Island shoreline (Puget Sound Estuary Program 1992).

The proposed project site encompasses approximately 800 linear feet of nearshore. If the entire linear extent of the site were to be considered eelgrass, this would represents 1.4 percent of the eelgrass habitat for Maury Island and about 0.5 percent of the eelgrass habitat of Vashon/Maury Island combined (Table 6-2).

The area of suitable shallow eelgrass habitat (< -22 feet MLLW) at the site is narrower than at other locations on the islands because of the narrow width of the shallow-water shelf. The shoreline at other locations (e.g., Quartermaster Harbor) does not drop off as rapidly, and these areas therefore provide larger areas of suitable eelgrass habitat.

Other Sea Plants. Bull kelp (*Nereocystis leutkeana*) is not present at the project site, based on diving surveys and the Puget Sound Environmental Atlas (Puget Sound Estuary Program 1992). The nearest patch indicated by the atlas is more than 1 mile away.

Other larger macroalgae (seaweed), including *Lamineria* spp. and *Ulva* spp., are common below the dock and surrounding areas. Both of these species are common in Puget Sound.

6.2.2.2 Geoducks

Geoduck clam (*Panope generosa*) beds are found along the entire southeastern shoreline of Maury Island, including the project site (Goodwin and Herren 1992, Sizemore et al. 1998).

Geoduck harvest is an economically important fishery in Puget Sound for both the State and Tribal Nations.

The site represents about 1 percent of the 149-acre Maury Island geoduck tract. A tract is an area that, in the opinion of state and Tribal biologists, contains sufficient densities to allow harvest. The Maury Island site has a moderate density of about 1 geoduck every 5 square feet (0.22 clams per square foot) (Sizemore et al. 1998). Near the site, geoducks generally occur from the subtidal nearshore zone to about 200 yards out.

The Puyallup Tribe and the WDNR both plan to harvest geoducks from this bed during the next few years. They will use water jets to blast away mud and sand around each clam hole and then pick up the clam by hand. This leaves small craters, about 2 feet wide and up to several feet deep, scattered about the sea floor.

Puyallup clam divers work four days per week between 8 a.m. and 4 p.m. (Winfree pers. comm.).

6.2.2.3 Herring

The NMFS is currently reviewing Pacific herring (*Clupea harengus pallasi)* for protection under ESA. Herring spawning occurs in shallow subtidal zones on vegetation and other shallow water substrate. Eelgrass is a preferred substrate for spawning, along with marine algae and sometimes other materials such as pilings and docks (Hart 1973). Most egg deposition occurs in substrates from 0 to –10 feet MLLW. After 10 to 14 days of incubation the larvae drift with currents, and undergo further development. At sexual maturity (2 to 4 years), herring migrate back to their natal spawning grounds.

About 52 percent of the Maury Island shoreline has been identified as herring spawning grounds by the Puget Sound Estuary Program (1992). The core herring spawning area on Maury Island is located in Quartermaster Harbor and extends to the Sandy Shores community, which is about 0.5 mile southwest of the site. The Quartermaster Harbor stock is considered to be “healthy” (Bargmann et al. 1998).

Herring probably spawn at the site, given that the proposed project site is located in proximity to known spawning areas, that herring spawning is typically associated with eelgrass, and that eelgrass is present at the site. Due to the patchy distribution of eelgrass, the site is not expected to be a major spawning ground. Herring are more likely to spawn at the site during high population cycles, as some individuals are forced away from more preferable spawning habitat. During low population cycles, the site may be used less or perhaps not at all.

Surveys for herring spawning at the site have not been undertaken. Direct surveys would be required to document the actual level of use, but for SEPA decisions regarding the proposal, it is adequate to conclude that some spawning occurs, but that this area is not a core area for spawning.

Herring, surf smelt (Section 6.2.2.4), and sand lance (Section 6.2.2.5) are important prey for birds, for marine mammals, and for other fish, such as salmon. Thus, herring, surf smelt, and sand lance are key components of the marine ecosystem in Puget Sound. In addition, both commercial and recreational fisheries use various forage fish species.

6.2.2.4 Surf Smelt

Although no surf smelt (*Hypomesus pretiosus*) spawning surveys have been completed at the site, spawning beaches have been noted southwest of the existing Glacier Northwest dock on the southeast shoreline of Maury Island between the point at Sandy Shores and Piner Point (Pentilla 1995a). Spawning beaches have also been identified northeast of the project site at Point Robinson. Surf smelt spawning occurs at high tide on mixed sand–gravel substrates in upper intertidal areas. Eggs adhere tightly to beach surface substrate and subsequent wave action disperses the eggs into the top several inches of beach material, where they incubate for 2 to 5 weeks (Bargmann et al. 1998). Due to the near proximity of surf smelt spawning beaches, it is likely surf smelt also spawn in the intertidal zone of the project site where appropriate substrate is available. The surf smelt stock in this area spawns from October through February of each year.

6.2.2.5 Sand Lance

Sand lance (*Ammonites hexapterus*) spawning areas have been identified in the same areas on Maury Island as mentioned above for surf smelt (Pentilla 1995b); thus it is also possible that sand lance spawning areas could be present in the intertidal zone at the project site where appropriate substrate is available. Sand lance are obligate upper intertidal spawners, depositing eggs in sand-gravel substrate between the mean high tide line and about +5 feet tidal elevation. Broods of eggs incubate in the beach for about 1 month after which larvae enter the nearshore plankton. Sand lance spawn from November through February and may spawn several times at any given site. Sites appear to be used year after year (Bargmann et al. 1998).

6.2.2.6 Salmon

Chinook, coho, pink, and chum salmon; steelhead; and sea-run cutthroat trout all use the intertidal environment of southern Puget Sound during the juvenile life stage. Juvenile salmon forage for tiny crustaceans and other animals among the substrate, algae, and eelgrass of the intertidal zone. Since no salmon-bearing rivers or streams are close to the site, juvenile salmon at the site are marine adapted and not in the more sensitive transition stage between fresh and salt waters. Larger salmon may also be found in deeper offshore habitat. Juvenile salmon use the intertidal zone around the existing dock, and larger salmon use the offshore habitat. Juvenile salmon are present primarily during late spring and early summer. Older salmon may be present offshore all year.

6.2.2.7 Dock and Sunken Barge Communities (Reef Habitat)

The dock, sunken pleasure boat, and two sunken wooden barges create high-relief habitat that supports typical piling and reef communities. The dock creates increased habitat for shellfish (barnacles, mussels, limpets, chitons etc.) and shellfish predators, including Dungeness crab and seastars. The shell fragments in this area (Figure 6-2b) provide substrate for the recruitment and settlement of larval Dungeness crab (Dumbauld et al. 1993). Dungeness crabs and seastars have been shown to negatively affect eelgrass through bioturbation associated with foraging and burrowing (Simenstad et al. 1997). The sunken boats as well as the dock provide habitat to lingcod, rockfish, greenling, and other reef fish. Many of the "reef" fish are predators of juvenile salmon and are also state-listed candidate species (described below). Table 6-3 provides a complete listing of organisms observed at the site during eelgrass surveys.

6.2.2.8 Rockfish

Several species of rockfish are currently under review by NMFS for protection under ESA. Brown rockfish (*Sebastes auriclatus*) and copper rockfish (*Sebastes caurinus)* have been identified in the site area, primarily associated with the man-made structures (dock and sunken barges). Generally, rockfishes inhabit rocky and artificial reef structures and other habitats with vertical relief. Eggs hatch internally in the female and are released as larvae during the spring. Larvae remain in the plankton for several months and then settle on marine vegetation and nearshore reef habitats. Rockfishes tend to be mid-level consumers and feed primarily on shrimp, crabs, and small fishes (including juvenile salmon). Copper and brown rockfishes are sedentary species and have small home ranges (~30 square meters on high-relief reefs). Rockfishes are long-lived species, with some reaching 75 years of age (Matthews et al. 1986).

6.2.2.9 Cod

Pacific Cod. Puget Sound Pacific cod (*Gadus macrocephalus)* has been petitioned for listing under the Endangered Species Act (ESA) and its status is currently under review with the National Marine Fisheries Service (NMFS) for further action. Pacific cod occurs throughout most of Puget Sound, typically in areas with deep (>80 feet) and cold water (> 10°C). Individuals spend much of their time near the bottom feeding on clams, worms, crabs, shrimp, and juvenile fish.

Puget Sound contains three stocks of Pacific cod, based upon fishery pattern, location of spawning grounds, parasitic markers, and tagging studies. The Maury Island site falls within the range of the southern stock. Populations of the southern stock have declined over the past several decades.

Spawning by Pacific cod has been documented by Washington Department of Fish and Wildlife biologists in waters 60 feet deep off Rosehilla, located approximately 1.2 miles southwest of the project area.

Pacific cod probably occurs in the deeper waters surrounding Vashon and Maury Island, including East Passage. However, Pacific cod is not expected to occur regularly at the proposed site because of its preference for waters deeper than 80 feet.

Walleye Pollock. Walleye pollock (*Theragra chalcogramma*), another member of the cod family, has been petitioned for listing under the ESA. Walleye Pollock are carnivorous, midwater, schooling codfish typically considered a northern, colder water species. Populations in Puget Sound are thought to be at the extreme southern end of their Pacific Coast distribution.

The southern Puget Sound stock of walleye pollock is considered distinct from the northern Puget Sound stock due to differences in growth rates and spatial separation during spawning. The southern stock has been declining since the 1980s and is at a critically low level and possibly extinct.

Little information is available on the life history of walleye Pollock in Puget Sound. Walleye pollock are known to spawn in Dalco Passage which is approximately 3 miles southwest of the project area. Adults are associated with both nearshore and deepwater habitats. As such, walleye pollock may occur near the project area but their frequency of occurrence is unknown.

Pacific Hake. Pacific hake (*Merluccius productus*) is a member of the hake family (*Merlucciidae*) and resembles cod externally. Pacific hake has been petitioned for listing under the ESA because of declining populations and smaller adult sizes. This species was heavily exploited by commercial fisheries during the mid 1980s and continues to experience considerable predation pressure from marine mammals. Marine mammal predation is thought to be a major factor limiting Pacific hake recovery.

Puget Sound Pacific hake are known to spawn primarily in Port Susan, approximately 50 miles north of the project area. Juvenile and adult hake are found in both nearshore and offshore habitats. Although pacific hake have not been documented at the Maury Island site, due to their wide distribution in Puget Sound it is likely that they periodically visit the project area.

Lingcod. Lingcod (*Ophidon elongates)* is part of the Hexagrammidae family and is not part of the codfish family (Gadidae). Lingcod is not currently listed under ESA but settlement and nursery areas are considered saltwater habitat of special concern by the Washington Department of Fish and Wildlife and WAC Hydraulic Code Rules (WAC 220-110-250). Lingcod occupies habitats with vertical relief commonly referred to as "reef" habitat. Individuals are territorial and lay eggs in nests, which they actively guard.

Lingcod occurs at the Maury Island site in "reef" habitat associated with the dock and the sunken barges. Lingcod eggs were observed near one of the sunken barges during dive surveys conducted at the site.

6.2.2.10 Bull Trout

Bull trout (*Salvelinus confluentus*) was listed as threatened under the Endangered Species Act on November 1, 1999 (Federal Register 64[210]:58910-58933). Several different life-history forms have been observed in this species, including stream-resident, fluvial, adfluvial, and anadromous. Of these life-history patterns only anadromous individuals venture into marine waters as adults. The other life-history forms (stream-resident, fluvial, and adfluvial), as well as juvenile and spawning anadromous bull trout, occur only in fresh water.

Adult anadromous bull trout may occasionally visit the Maury Island site area while foraging in the marine environment. They are opportunistic feeders and prey on many organisms, including small fish such as sculpins and juvenile salmon.

Mature anadromous bull trout return to freshwater between late May and September and spawn between August and November. Sub-adult anadromous forms migrate from the marine environment in the fall and early winter, to overwinter in freshwater.

Populations of native char (which include bull trout and Dolly Varden) have been identified in several rivers in the Puget Sound Basin, including the Nisqually, Puyallup, and Green Rivers. Due to the difficulty in distinguishing between Dolly Varden (not a threatened species) and bull trout, it is uncertain whether anadromous bull trout are present in these drainages.

6.2.3 Other Considerations of the Marine Environment

6.2.3.1 Recreational Fisheries

With the exception of geoduck beds, as described earlier, no recreational shellfish beaches or commercial shellfish beds are designated or monitored on the southeast shoreline of Maury Island by the Washington State Department of Health (Washington Department of Health 1996). However, local residents and visitors have indicated periodic use of the site, including the dock, for recreational gathering of clams and crabs. Other less economically important species of fish and invertebrate are likely found along the shoreline of the project site.

Some recreational catch of chinook salmon is known to occur offshore from the project site.

6.3 Impacts

6.3.1 How would shading from barges at the dock adversely affect eelgrass or other marine biological communities?

Light is a major factor determining the characteristics of marine communities. Shorelines are zones of shallow water where considerable light reaches the subsurface, thus supporting plant and animal production. This is why shorelines are particularly productive ecosystems.

Shading could be caused by shadows cast by barges, tugs, and the dock, as well as by sediments and air bubbles created by tug prop wash (prop wash is the turbulence created by the thrust of propellers). This section addresses the impacts of shading due to barges and tugs. Section 6.3.4 addresses shading from prop wash and Section 6.3.8 addresses shading from the dock.

Light and Eelgrass. Eelgrass, like any photosynthesizing plant, requires light. Both natural and human factors can affect water clarity and thereby decrease the depth to which light penetrates adequately for eelgrass growth. Some of these factors are plankton abundance, pollution, turbidity from runoff, and shading from overwater structures.

Shading from Washington State Ferry terminal structures, turbulence from ferry vessel traffic, and bioturbation (foraging and burrowing by seastars and crabs) have been identified as factors limiting eelgrass distribution near ferry terminals (Thom et al. 1995).

Light and Other Marine Biological Communities. Like eelgrass, many other plants and animals require light. Most notably, macroalgae (commonly called seaweeds) are limited by light, although they tend to be able to grow in deeper water than eelgrass. Other organisms may depend indirectly on light, since they use habitats created by macroalgae and other light-dependent organisms.

6.3.1.1 Proposed Action

Eelgrass. Three patches of eelgrass could be partially shaded and, therefore, reduced in area.

- Patch 1: a 20- by 20-foot patch located about 30 feet from the end of the dock (along transect line N1 in Figure 6-2a);
- Patch 2: a 40- by 60-foot eelgrass patch, extending out between the dolphins located about 300 feet north of the dock (along transect line N7 in Figure 6-2a); and
- Patch 3: a 50- by 60-foot eelgrass patch, landward of the dolphins, located about 200 feet south of the dock (along transect line S6 in Figure 6-2a).

Patch 1 would be indirectly shaded when the sun is low in the sky. This 20-foot by 20-foot patch is located a few feet north of the dock and about 30 feet shoreward of where barges would be loaded.

Shading would be greatest during winter, when the sun is low in the sky and not contributing a large amount of light and when eelgrass is in a period of slow growth (Figure 6-4).

Patch 2 could be shaded directly, since the patch extends seaward of the dolphins. Since this patch is 300 feet from the loading area, most shading would occur only during arrival or departure of barges. Shading could also occur during loading, but only in an extreme situation. This situation would arise should a barge be positioned as far north as it could while still under the loading area, and if a tug was at the northern end of this barge. In such situations, the patch would be directly shaded.

This shading could reduce the extent of this patch but is not expected to eliminate this patch, since shading would be intermittent, occurring only during arrival and departure and/or when a barge is shifted as far north as possible while being loaded.

Patch 3 would be shaded during barge loading, when barges were moved to the south to fill the northernmost part of the barge.

The other patches of eelgrass at the site would not be shaded because they are sufficiently far from the barge loading area where shading would occur.

Other Marine Biological Communities. Much of the area underneath the loading area would be directly shaded by barges and tugs.

Shading would be concentrated around the end of the conveyor, since this area would be shaded almost constantly during peak operation. Because barges would be moved back and forth during loading, the duration of shading would decrease as the distance from this point increases.

The impact would occur in an area of human-made reef habitat. This habitat type is not particularly common along the south shore of Maury Island.

The extent of macroalgae (*Laminaria* spp. and *Ulva* spp.) located directly beneath where the barges would be loaded would be reduced due to shading. These species are relatively common and impacts would be limited in extent to the area immediately surrounding the dock.

Moreover, shading (and noise) is not expected to totally eliminate use of the area by marine organisms. Ferry docks and other active and/or shaded areas are known to support relatively rich communities of reef-oriented species.

6.3.1.2 Alternative 1

Shading effects from Alternative 1 would be essentially the same as under the Proposed Action. Barges could be tied up at the dock during daylight hours, since night loading would not occur. However, as discussed under the Proposed Action, this would not significantly shade eelgrass beds.

6.3.1.3 Alternative 2

Shading effects from Alternative 2 would be essentially the same as under the Proposed Action. Barges would be loaded only during daylight hours, but fewer average hours per day would be required at this level of output than under the Proposed Action. As discussed under the Proposed Action, eelgrass beds would not be significantly shaded.

6.3.1.4 No-Action

Under the No-Action Alternative, as defined in Chapter 2, there would be no barge activity or modifications to the dock and no change in shading of the marine environment.

6.3.2 How would accidental spillage of sand and gravel during barge loading adversely affect marine life under or near the dock and barges?

6.3.2.1 Proposed Action

Some spilling of mined material is inevitable with a project of this scale.

Due to the high volumes of materials proposed to be loaded under maximum production levels, state agencies and the public expressed concern about the frequency and quantity of accidental spillage. The concern is that spilled sand and gravel would bury marine organisms. Further literature review, discussions with loading facility operators, and a dive survey at a currently active barge-loading facility in Dupont were conducted to supplement the analysis presented in the DEIS.

Two categories of accidental spillage have been evaluated: (1) spillage due to a barge sinking or other accident, leading to a major input of sand and gravel into the water; and (2) accidental spillage of smaller amounts from the conveyor and around the barges during normal loading operations.

Barge Accident Spillage. A major spill, such as may occur with a barge sinking at the dock, would bury geoducks, clams, kelp and other sedentary marine life that exist under the loading area. Salvage or other removal of spilled material may further disrupt the sediments. The rate of recovery of the benthic meiofauna (small invertebrates living in sediments) following disturbance is on the order of days to months (Sherman and Coull 1980). Full recovery could take several years.

The probability of a large spill due to a loaded barge overturning or sinking is low. No loaded barges have been lost pierside at any of the Applicant's mining operations in Puget Sound. Two barges have sunk in transit (one in Lake Union and one in Elliot Bay).

Conveyor Spillage. Spilling during routine operations is by far the greatest concern, since, without extensive protective measures, spilling could occur regularly over long periods of time, thereby directly burying marine organisms.

Estimates of spillage for a conveyor system are 1 pound per foot of conveyor per year (City of Dupont 1993). This estimate was based on an unprotected (without spill tray or wind guard) conveyor, with annual production of 3 to 4 million tons. The Maury Island site, at maximum annual production of 7.5 million tons, would approximately double this figure, leading to potential spillage of 2 pounds per foot of conveyor per year. There are approximately 300 feet of conveyor located over the nearshore, so up to 600 pounds of material could be spilled per year if no protective systems were utilized.

Some spillage of sand and gravel is inevitable. Spilling is expected to occur immediately below the point were the conveyor meets the barge, resulting in some reduction in shellfish, algae, and other marine organisms directly below the loading point (as has been documented to occur at the Dupont site and in previous operations at Maury Island).

Spilling could also occur along the conveyor itself. While the proposed spill tray could be designed to capture much of this spillage, some additional spilling would be expected during manual cleaning of the tray.

Spillage Around Barges during Loading. A dive survey conducted at the active Dupont barge-loading facility revealed that significant amounts of spillage occurred around the sides of the barges being loaded (Appendix K). The volume of spillage was sufficient to create mounds 3 to 10 feet high and 5 to 15 feet long. Gravel accumulation was limited to the range of motion of the loading arm (movable boom) used at this facility. It is likely that the gravel spills were caused by using the movable boom to load the barge to maximum capacity.

The gravel deposited at the Dupont facility did not have significant algal accumulations or show signs of recruitment of other marine organisms. The benthic community around the gravel mounds and further along the dock did not appear to be significantly altered from pre-facility construction conditions, based on a comparison with videos of underwater surveys completed pre-construction (video tapes provided by Glacier Northwest). There was no evidence of significant transport of material away from the immediate loading zone by currents. Additionally, there did not appear to be significant accumulation of fine sediments around the loading facility.

Because the Maury Island loading dock is not proposed to be equipped with a movable boom, spillage would be limited in lateral extent to the areas directly off the end of the conveyor (on either side of the barge). If amounts of spillage were similar to those found at the Dupont facility, burial of attached or sessile (non-moving) benthic organisms would occur.

Recovery may be delayed and take up to several years, depending on the quantity and the frequency of spillage. Long-term effects, after spillage ceased, would be minimal as the material being loaded is similar to the substrate currently at the end of the pier. There would be rapid re-colonization of the benthic substrate and community re-establishment would take place over the course of several years. Studies on the effects of adding gravel to intertidal sandflats in Puget Sound indicated increased net productivity in comparison to control plots (Thom et al. 1994). Certain meiofauna that are important in the diet of juvenile salmon were also higher in plots with added gravel (Simentstad et al. 1991). Additionally, clam production on graveled areas has been shown to increase on the order of 2 to 10 times versus ungraveled substrate (Thompson and Cooke 1991, as cited in Thom et al. 1994).

Effects on the larger surrounding area, including eelgrass beds, would not be significant. Larger grain sizes would settle rapidly and would therefore be deposited only in the immediate vicinity of the end of the dock. Smaller grain sizes, which may be transported by currents, would be dispersed over a large area. Deposition rates due to dispersal of fine-grained sediments are expected to be less than during commonly occurring natural events (e.g., storm wave action). (The effects of suspended sediments on marine organisms are discussed further in Section 6.3.4.)

Over time, the accumulated pile of sand and gravel could interfere with loading. Currently the shallowest point at the end of the dock, where barges would be located, is 20 feet deep at MLLW

(Figure 6-1b). A fully loaded 10,000-ton barge has a draft of 16 to 17 feet. Significant spillage at the end of the conveyor at the Maury Island site could decrease water depth and cause a loaded barge to rest against the bottom during negative tides, causing additional disturbance to the sediments.

6.3.2.2 Alternative 1

The potential for spills due to a barge accident would be somewhat less than under the Proposed Action, since less material would be loaded with the conveyor system.

Impacts from conveyor spillage would be about the same, even though the accumulation may be less due to lower peak volumes.

6.3.2.3 Alternative 2

Same as Alternative 1.

6.3.2.4 No-Action

Under the No-Action Alternative, no sand and gravel would be loaded using the conveyor system and there would be no risk of accidental sand and gravel spillage.

6.3.3 What would be the potential for petroleum spills from increased marine equipment activity?

6.3.3.1 Proposed Action

The possibility of accidental spills of petroleum products due to the proposal is minor because:

- No vessel refueling would take place at the project site, reducing the risk of petroleum spills.
- All vessels would operate in compliance with Coast Guard regulations to limit the potential for petroleum spills.
- Barges would be hauling sand and gravel, not petroleum products.
- All vessels would operate with spill containment equipment aboard.

The tug boats most likely to be used at the site carry between 25,000 and 80,000 gallons of diesel fuel, 300 to 1,000 gallons of lube oil, and 55 to 200 gallons of hydraulic oil. Normal operations of the vessels do not result in significant spillage of petroleum products.

As with any boat, tugs would release oil and diesel into the water from their exhausts. The small amounts would disperse quickly. Currents would move and dilute such inputs and any one area is unlikely to be impacted repeatedly. The invertebrate communities that develop on the pilings may accumulate some hydrocarbons in their tissue from repeated exposure. Mortality to the piling communities is unlikely and long-term accumulation would not be significant because of the intermittent nature of the inputs and the rapid rate of depuration (cleaning-out) of most compounds from animal tissues (Anderson 1977, Rossi 1977). Studies have shown very low accumulation of polycyclic aromatic hydrocarbons (PAHs, a group of chemicals associated with petroleum products) in fish or other higher trophic levels when feeding on contaminated animals (McElroy et al. 1989).

A major accident or equipment failure could result in significant spillage of diesel fuel and smaller amounts of hydraulic oil. The amount would depend on the size of tug used, which may include tugs with fuel capacity up to 80,000 gallons. There are numerous studies investigating the effects of petroleum products on marine organisms. Most work has been done after large spills involving hundreds of thousands of gallons. Refined fuels, including diesel, tend to oxidize and volatilize more rapidly than crude oil or bunker fuel oil and do not remain in the system as long. However, more highly refined fuels also tend to be more toxic to organisms (Zieman 1982).

In past spills of diesel fuel, such as the Guemes Island spill in northwest Washington, sensitive shoreline intertidal invertebrates (shore crabs, amphipods, clams, limpets, and snails) were affected and mortality was high. Recolonization and recovery of these areas occurred within 6 months (Woodin et al. 1972).

Studies made on eelgrass following oil spills have shown temporary damage to blades if the oil contacts the blade in air. If the leaf remains covered with water, there is no apparent damage. Rhizomes and roots do not appear to be damaged in any case. It is possible that a spill in spring could interrupt the production and/or viability of pollen from immature flowers (Phillips 1984).

For shorebirds, oiling, loss of food, or consumption of tainted food are the greatest potential impacts. For fishes, the greatest impacts occur on bottom dwellers. Flatfish may develop tumors on their ventral surfaces when they come in contact with polluted sediments. Crabs, mollusks, and annelids (worms) appear to be highly resistant to oil contamination. Smaller crustaceans are more severely affected (Phillips 1984). Sand lance and surf smelt spawning habitat can be damaged or destroyed by oiling (Bargmann 1998).

The chances of a major accident at the site are small, even at maximum production levels.

6.3.3.2 Alternative 1

The potential risk of accidental petroleum spills under Alternative 1 would be similar but less than that under the Proposed Action because fewer loading hours would likely occur each day.

6.3.3.3 Alternative 2

The potential risk of accidental petroleum spills under Alternative 2 would be similar but less than that under the Proposed Action or Alternative 1 because fewer loading hours would likely occur each day.

6.3.3.4 No-Action

Under the No-Action Alternative, as defined in Chapter 2, there would be no barge loading and therefore no risk of petroleum spills from marine traffic due to the project.

6.3.4 Would stormwater, propeller wash, or barge grounding affect marine organisms?

6.3.4.1 Proposed Action

Stormwater. Muddy water generated on the mining site would not enter marine waters and reduce marine water quality. Surface water from the mining operation would not flow directly from the site to marine waters, but would rather infiltrate through the ground, thereby filtering out sediments. No washing of excavated material would occur onsite. Therefore, the potential for impacts to groundwater quality from mining operations is evaluated in

Chapter 4, Geology/Hydrogeology, and Chapter 10, Environmental Health and Safety.

Prop Wash. When under power, the propellers of tug boats create powerful currents known as prop wash. In shallow water, prop wash can scour the bottom, raise sediments, and harm marine life, such as eelgrass. Prop wash could potentially affect marine organisms through three primary mechanisms, (1) scouring, (2) suspended sediment, and (3) shading caused by air bubbles and increased turbidity.

Scouring. Scouring is caused by the effect of currents generated by the propeller on bottom sediments. When currents reach sufficient velocity, sediments are resuspended, harming or eliminating the attached plants and animals. The potential effects of scouring on specific marine resources are described in the following paragraphs.

Eelgrass. Three patches of eelgrass could be damaged by scouring from prop wash if tug operations are unrestricted:

- Patch 1: a 20- by 20-foot patch located about 30 feet from the end of the dock (along transect line N1 in Figure 6-2a);
- Patch 2: a 40- by 60-foot eelgrass patch, extending out between the dolphins located about 300 feet north of the dock (along transect line N7 in Figure 6-2a); and
- Patch 3: a 50- by 60-foot eelgrass patch, landward of the dolphins, located about 200 feet south of the dock (along transect line S6 in Figure 6-2a).

A review of the scientific literature indicates that eelgrass is relatively tolerant of elevated currents (Fonseca and Kenworthy 1987). Phillips (1984) described eelgrass patches, in suitable substrate, surviving in Puget Sound where tidal velocities are as great as 200 cm/sec. (4.5 miles per hour [mph]). Optimal growth was noted under conditions with currents 30 to 40 cm/sec (0.7 to 0.9 mph). Studies conducted to asses the impact of propeller wash from Washington State Ferries indicated that currents with a velocity above 75 cm/sec (1.7 mph) damaged eelgrass by eroding away the overlying sediment and that currents above 110 cm/sec (2.5 mph) caused extensive damage to eelgrass rhizomes (Hart Crowser 1997).

Based on previous studies, direct prop wash from tugs could affect eelgrass up to at least 100 feet away and probably considerably further. Hart Crowser (1997) found that a 30 m (~100 feet) setback was adequate to protect eelgrass from passenger ferries. However, the vessel evaluated had about half the horsepower of tugs (1,445 hp versus up to 3,000 for tugs) and twin 46-inch diameter screws rather than a single prop about twice that size. The modeling of prop wash is extremely complex and involves so many variables that could change at the project site (e.g., vessel characteristics, current, barge size, tides, wind) that specific modeling and prediction are not feasible. Therefore, an exact limit of impact cannot be predicted. Still, it is reasonable to expect considerable damage to eelgrass beds if prop wash is oriented directly at the beds.

Sunken Barges. The sunken wooden barges and associated habitat are vulnerable to being damaged by prop wash scouring. The elevated currents could dislodge, damage, and/or rearrange the "reef" structure provided by the barges. The majority of organisms associated with the barges depend on this structure to provide the habitat they require.

Most of the reef habitat provided by the sunken barges is in water deep enough to avoid the effects of prop wash. However, the shallow end of the northernmost barge could be damaged by the proposed operations as tug boats position barges at the dock during arrival, loading, and departure.

Fish Eggs. Herring, surf smelt, sand lance, rockfish, and lingcod all potentially deposit their eggs at the Maury Island site. Many species of fish, including herring and lingcod, attach their eggs to various substrates such as eelgrass. Prop wash scouring, primarily due to the rearrangement of the substrate, could damage eggs of these species. If the substrate were rearranged, the eggs could become buried and thereby destroyed or suffocated.

Sand lance and surf smelt spawn in upper intertidal areas of sandy beaches. The upper intertidal area is not expected to be influenced by prop wash because it is more than 250 feet away from where tug boats would be operating. Moreover, the upper intertidal area is consistently exposed to wave action, which rearranges the sediments, and the eggs of both sand lance and surf smelt are thus adapted to these conditions and would most likely be unaffected.

Rockfish eggs hatch internally in the female. Young are released as larvae to drift with the currents for several months. Currents may be elevated due to prop wash but this is not expected to harm the larvae.

Herring spawn in shallow subtidal zones on vegetation and other shallow water substrate. Eelgrass is a preferred substrate for spawning, along with marine algae and sometimes other materials, such as pilings and docks (Hart 1973). Most egg deposition occurs at tidal elevations of 0 to –10 feet. If prop wash is sufficient to damage eelgrass, some damage to herring eggs attached to the eelgrass may occur.

Suspended Sediment. Prop wash can resuspend sediments when elevated currents interact with the bottom. Suspended sediment can harm marine organisms that depend on clear water for their survival. When suspended sediments settle out of the water column they can accumulate and bury attached organisms not adapted to such processes. Currents can transport the suspended sediments away from their origin and deposit them at more distant locations. As a point of reference, typical concentrations of suspended sediment in the immediate vicinity of dredging activity is around 2 to 400 mg/l (Kiorboe et al. 1981). Significantly less suspended matter would be expected from propeller wash associated with tug activities.

Eelgrass. Eelgrass is adapted to some sedimentation. A primary ecological function of eelgrass beds is to capture and stabilize sediments (Phillips 1984). The growth rate of eelgrass shoots is sufficient to avoid burial due to increased sedimentation. Eelgrass distribution would be limited more by light reduction from suspended sediments than by burial from suspended sediments. The effects on eelgrass of light reduction due to increased turbidity and air bubbles are discussed below.

Salmon and Other Fish. Salmon encounter high levels of suspended sediments under natural conditions. Servizi and Marten (1992) reported that suspended sediment concentrations in the Fraser River are typically 300 to 600 mg/l and occasionally exceed 1,000 mg/l. During tests with under-yearling coho salmon, no mortality was observed when fish were exposed to concentrations as high as 6,900 mg/l, but the fish exhibited avoidance at 300 mg/l (Servizi and Martens 1992). Cyrus and Blaber (1987a, b) suggest that several species of marine and anadromous fish appear to prefer turbid over clear water during early life stages. On the other hand, in laboratory experiments using aquaria, juvenile chum salmon showed avoidance to suspended sediments at all levels tested and the fish would either return to clear water or go to the surface. However, individual fish in this experiment did occasionally stay in the turbid water for extended periods of time (Martin et al. 1976).

Several researchers have suggested the "turbidity as cover" hypothesis, according to which turbidity may reduce predation pressure on young salmonids, thereby providing a form of protective cover and enabling them to evade detection or capture by predators (Blaber and Blaber 1980, Grandall and Swenson 1982, Simenstad et al. 1982). Gregory (1992) concluded that although high concentrations of suspended solids cause physiological and behavioral stress, lower concentrations may reduce predation on juveniles.

Suspended sediments are not expected to affect salmon under the proposed operations. Studies conducted to assess the impact of propeller wash from Washington State ferries indicate that the bubble plume and suspended sediments persist for only several minutes after the arrival or departure of vessels (Simenstad et al. 1997). If propeller wash were sufficient to suspend sediments near juvenile salmon, concentrations would not be high enough or of a long enough duration to harm the fish. Additionally, predators would be affected by the same conditions and would not gain any advantage.

Fish Eggs and Larvae. Studies on the effects of suspended sediments on eggs and larvae from various species of fish indicate a fairly high tolerance to suspended sediment exposure (Swenson and Matson 1972, Morgan et al. 1983). Experiments on feeding abilities of newly hatched herring larvae showed that feeding increased significantly at suspended sediment concentrations of 500 to 1,000 mg/l. At concentrations greater than 1,000 mg/l feeding decreased. It was concluded that feeding abilities are adapted to residence in turbid (0 to 100 mg/l) estuarine environments occupied during the larval growth stage (Boehlert and Morgan 1985).

Studies found no correlation between suspended sediment concentrations and herring embryonic development or egg mortality for tested concentrations up to 300 mg/l. Visual inspection showed that practically no particles adhered to eggs even though they were smothered with settled material (Kiorboe et al. 1981). At concentrations of 10,000 mg/l hatching was delayed for herring, surf smelt, and lingcod eggs. Surf smelt were more sensitive to suspended sediments than lingcod and herring (Morgan and Levings 1989).

Since most species of estuarine fish are adapted to naturally occurring high levels of turbidity, the potential increase in turbidity and deposition of fine sediments associated with prop wash is not expected to reach critical levels at the Glacier Northwest site.

Shading from Bubbles and Increased Turbidity. Prop wash can affect light levels by increasing the number of air bubbles and the concentration of suspended sediments. Both air bubbles and suspended sediment cause the absorption, refraction, and reflection of light, thereby reducing the amount of light available for marine organisms.

Eelgrass. As discussed in Section 6.3.1 shading can adversely affect eelgrass. When light levels are reduced to below 3 moles of photosynthetically active radiation (PAR) per square meter per day (M/m^2/day) for a period of 1 to 2 weeks eelgrass plants may die (Simenstad et al. 1997).

During tug and barge arrival and departure, light reduction over eelgrass beds from bubbles and suspended sediments would occur only briefly and intermittently and would therefore not be significant. There would be a maximum of four arrivals and four departures during daylight hours. This level of activity would not reduce irradiance below the necessary 3 M/m^2/day PAR. However, during loading the positioning of the barges could direct bubbles and suspended sediments over eelgrass patch 2 (along transect line N7 in Figure 6-2a) if the tug were attached to the northern end of the barge. Since barge repositioning would need to occur relatively frequently during loading, this patch could be reduced due to shading from bubbles and suspended sediment.

Sunken Barges. The sunken barges would receive less light under the proposed operations as tug boats position barges at the dock during arrival, loading, and departure. Since positioning during loading would be an ongoing process, the sunken barges could be shaded virtually continuously while a barge is at the facility. The light reduction due to this activity could significantly alter the plant communities associated with the sunken barges.

Summary. As proposed, there would be no restrictions on tug boat operations at the Maury Island site. If unrestricted vessel operations were allowed, marine organisms, including three eelgrass patches and a portion of one of the sunken barges, could be adversely affected by elevated currents and associated scouring due to propeller wash. Furthermore, shading from bubbles and suspended sediments could adversely affect one eelgrass patch and the plant communities associated with the sunken barges if tug boats were used to position barges during loading.

6.3.4.2 Alternative 1

The potential for sediment disturbance effects from Alternative 1 would be somewhat less than under the Proposed Action, since this alternative would involve fewer barge loads per day during peak periods.

6.3.4.3 Alternative 2

The potential for sediment disturbance effects from Alternative 2 would be somewhat less than under the Proposed Action or Alternative 1, since this alternative would require fewer barge loads daily than either of the other action alternatives.

6.3.4.4 No-Action

Under the No-Action Alternative, there would be no potential for marine sediment disturbance due to the project since no barge loading or shipping would take place.

6.3.5 Would removing a portion of the bluff during mining change the deposition/ erosion dynamics of the beach?

6.3.5.1 Proposed Action

About half of the bluff along the southeastern side of the site would be removed. Maintenance of beaches requires deposition and erosion of rock, sand, and sediment. Therefore, changes in material available for deposition through bluff erosion could result in changes in the characteristics of the beach below. Typically, the sand component is reduced, as often occurs due to bulkheading.

Shoreline stabilization structures (bulkheads and riprap) are present along waterfront communities north and south of the project site (Figure 11-5). These structures probably reduce natural sediment movement (alongshore littoral drift) to the project site and reduce habitat quality in the area.

The Applicant would leave a 200-foot vegetated buffer from the beach inland under the Proposed Action. This buffer would continue to provide protection against erosion and would be expected to maintain approximately the existing conditions of sediment input from the bluff to the beach. The upper areas that would be removed are well vegetated and are not expected to be contributing greatly to shoreline sediments. Thus, the erosion and deposition dynamics of the beach are not expected to change with implementation of this project.

6.3.5.2 Alternative 1

The effects of removing a portion of the bluff would be the same under Alternative 1 as under the Proposed Action, except that the change in topography would presumably take place over a longer time since mining would occur at a slower rate.

6.3.5.3 Alternative 2

The effects of removing a portion of the bluff would be the same under Alternative 2 as under the Proposed Action. The change in topography would take place over a longer period than under either the Proposed Action or Alternative 1.

6.3.5.4 No-Action

Under the No-Action Alternative, mining would continue at the site, but at very low levels. Changes in the topography would occur slowly over many years. No changes in beach erosion/deposition dynamics would be expected.

6.3.6 What effect would the project have on geoduck clam harvest by the Puyallup Tribe?

6.3.6.1 Proposed Action

During barge loading operations, it would be unsafe for geoduck divers to work in the vicinity of the end of, or approaches to, the dock. Geoduck harvesting limits have been established as 2.7 percent of the biomass estimated for the region. Typically this limit is attained by the concentrated harvesting of geoducks in as small an area of a tract as possible. This is done to localize harvesting impacts and to potentially aid recruitment to the harvested site by leaving surrounding geoduck beds intact. If an agreement with WDNR and the Tribes can be reached the area could be harvested prior to any construction or barging activity at the site. If no agreement can be reached compensation for lost harvest would be necessary.

6.3.6.2 Alternative 1

The effect of Alternative 1 on geoduck harvest would be the same as under the Proposed Action, except that it might be more difficult to schedule access for geoduck divers, since barge loading could occur only during more limited hours.

6.3.6.3 Alternative 2

The effect of Alternative 2 on geoduck harvest would be the same as under Alternative 1.

6.3.6.4 No-Action

Under the No-Action Alternative, as defined in Chapter 2, no barge loading would occur. Therefore, there would be no reduction in access to the site by geoduck divers.

6.3.7 Would the noise and vibration from pile driving or barge loading affect salmon and other marine animals, including whales?

6.3.7.1 Proposed Action

Pile driving and barge loading would create noise and vibrations underwater. For this project, King County technical staff, citizens, and the WDFW have voiced concern that the noise would harm juvenile salmon, herring, and other fishes, as well as marine mammals.

Large salmon (those that have been in saltwater for more than a few months) would likely use the area around loading barges less. As salmon mature, they tend to occur in very deep waters and, thus, larger salmon and mature salmon returning to spawn are not likely to be affected by the project.

For salmon, the primary concern is related to juvenile migration, feeding, and rearing, as identified in WAC 220-110-271. Based on the known biology of salmon, the key concern for juvenile salmon is activity near the mouths of rivers. During migration to saltwater from freshwater (which occurs in the spring), juvenile salmon often linger close to the mouths of rivers where freshwater is still present. As they arrive in these areas, they may stay near the surface and in shallow areas along the shore, where a “lens” of freshwater is present. They stay within this freshwater lens as they slowly adjust to saltwater conditions.

Because juvenile salmon tend to congregate at the mouths of rivers, and because their movements are restricted due to their limited adaptability to saltwater, construction work near the mouths of major rivers poses the greatest potential risk to juvenile salmon.

At the Maury Island site, this use of a freshwater lens is not an issue. Since no river is nearby, the waters near the dock do not contain significant freshwater layers nor do they receive juvenile salmon fresh from the river, but rather fully adapted marine-stage juvenile salmon. Therefore, the most serious concern for migrating juvenile salmon (impacts during the relatively vulnerable time when fish are transitioning from freshwater to saltwater metabolism) is not an issue at the Maury Island site.

Once migrating juvenile salmon adjust to the marine environment near the mouths of rivers, they begin to disperse and head toward sea, where they spend the next several years before returning to spawn. When they first leave the estuarine areas, these fish stay very near the shoreline. Biologists speculate that they do this to avoid predators and feed in the productive shoreline habitats. As the fish become larger (typically by midsummer), they venture into deeper water.

Therefore, essentially all shallow shoreline areas are potential juvenile salmon rearing and migration habitat during spring and early summer. It follows that salt-water adapted juvenile salmon occur near and around the existing dock and, in particular, close to low-tide level where some eelgrass beds are present. The shoreline area is part of the overall shoreline habitat used by juvenile salmon throughout Puget Sound.

Since salt-water adapted juvenile salmon are expected to occur near the project site, repair, maintenance, and operation of the dock and associated tugs and barges under the Proposed Action and Alternatives 1 and 2 could cause juvenile salmon to disperse, school, startle, or otherwise react to noise. This reaction could conceivably increase their risk of falling prey to larger fish or birds. Dock repair and construction are known to have some effects on juvenile salmon, and, intuitively, it makes sense that construction activity (especially pile driving) would cause some fish to leave the area.

However, in a study conducted for the U.S. Navy Home Port at the mouth of the Snohomish River (a known juvenile salmon migration route), the actual effects of pile driving on juvenile salmon were observed to be relatively minor (Anderson 1990). While juvenile salmon occurred in lower numbers near active pile driving operations, the study found that the decrease was “subtle” and that juvenile salmon were often observed "milling around the pile driving rigs during active pile driving." As is the case with most animals, salmon are expected to tolerate certain constant noise and disturbance. Noise and vibration from shoreline activities, such as those that would occur at the project site, are not significant factors contributing to the decline of salmon populations (in contrast to dams, harvest, and destruction of spawning habitat).

A number of studies assess hearing in adult and juvenile salmonids. Many of these studies have focused on attempts to divert fish from dam turbines using sound and have met with no, or at best limited, success (Mueller et al. 1998). Salmonids are considered hearing generalists and their sound sensory system responds to the particle motion component of sound. Juveniles showed avoidance response to 10-Hz signals but not to 150 Hz, although avoidance at the 10-Hz signal occurred only if the fish was within about 3 feet (1 m) of the sound source (Knudsen et al. 1992). Low-frequency sounds propagate very poorly in shallow water because the wavelength is larger than the depth. The lowest frequency that will propagate is 300 Hz in water about 3 feet (1 m) deep and 30 Hz in water about 35 feet (10 m) deep (Rogers and Cox 1988).

Based on these considerations, the overall magnitude of the effects on salmon from barge loading and dock repairs at the Maury Island site would be relatively minor. The risks would be reduced by restricting construction activities as required by WAC 220-110-271 (no construction between March 15 and June 14 of any given year).

Herring. There is some evidence in the literature that herring respond to sounds produced by approaching large vessels (about 50 to 65 feet). Fishermen refer to the need for herring to "harden", which they define as the process by which the fish become more accustomed to the presence of moving vessels. Fishermen typically delay fishing for several days so that hardening can take place. This process is more common along the open coast than the inner coast, suggesting that the exposure of herring to the noise of continuous vessel traffic while the fish migrate through inner waters of the Puget Sound Region may assist in the "hardening" process (Schwarz and Greer 1984).

The primary shipping lanes serving Tacoma and south Puget Sound run adjacent to the Maury Island shoreline (Figure 8-2). According to U.S. Coast Guard statistics, 4,883 vessels that participated in the Vessel Traffic Service (see Chapter 8 for further discussion) transited through the East Passage adjacent to the Maury Island shoreline between April 1999 and April 2000 (Appendix L). This translates to approximately 13.4 vessels/day, although higher and lower volume days occur. The southbound shipping lanes pass within 1,500 yards of the entrance to Quartermaster Harbor, which contains the active spawning grounds of the Quartermaster Harbor herring stock. The Quartermaster Harbor stock is considered "healthy" by WDFW and the shipping traffic does not appear to have influenced spawning behavior. It is unlikely that noise generated at the Glacier Northwest site (approximately 2 miles from the entrance to Quartermaster Harbor) from approaching and departing vessels, gravel loading, or pile driving would have any effect on the Quartermaster Harbor stock. As with salmon, attempts to divert herring using sound have been largely unsuccessful (Nestler et al. 1992).

The precise effect of the increased noise from the Proposed Action is difficult to determine. Very little habitat is even present at the site, but the WDFW considers any possible herring habitat as important. Since the effects cannot be predicted precisely, King County is assuming that herring spawning at the site would be "reduced." The importance of this reduction is questionable, since herring are believed to spawn at the site mainly during high population cycles, when higher quality habitat south of the site is fully utilized.

Marine Mammals. For marine mammals, such as whales, seals, and sea lions, construction and activity at the project site would cause negligible effects. The basis for this conclusion is related to the context of the Puget Sound environment. Shipping traffic and port activities are a commonplace reality for the marine mammals that inhabit the area. For example, seals and sea lions are common at the Ballard Locks and Shilshole Bay, where ship traffic, noise, and human disturbance levels are very high. In addition, the project site is not located at any major feeding ground, congregation point, breeding area, or migration route for marine mammals.

The most likely effect of the project on marine mammals would be avoidance of the area by harbor seals during times when barges are being loaded. Harbor seals tend to avoid areas of high human disturbance. Nevertheless, harbor seals have been observed in relatively high human use areas, including Elliott Bay.

Killer or orca whales are the most commonly occurring resident whale species. Resident pods travel throughout Puget Sound for much of the year. The typical range of the southern resident orca community encompasses the entire inland waterways of Puget Sound, the San Juan Islands, and the Georgia Strait in Canadian waters. They are known to travel at least 300 miles up and down the coasts of Washington to the south, and along Vancouver Island to the north. It is not known how far offshore into the Pacific Ocean they may travel. They usually swim from 75 to 100 miles every 24 hours. They are not expected to be affected by the project since they have been shown to be adapted to the presence of humans and related noises and activities. Killer whale populations are declining, but activities in central Puget Sound have not been considered as a contributing factor to this decline.

Recent hypothesis over the causative factors for orca deaths are related to bioaccumulation of PCBs and other toxins thought to suppress immune system functioning.

As mentioned above, the shipping lanes serving Tacoma and south Puget Sound run adjacent to Maury Island. Approximately 13.4 vessels transit through East Passage per day and therefore marine mammals, which commonly occur in this area, appear to be tolerant of human activity.

Other species of whale, including gray and minke, occur sporadically in Puget Sound and may travel in the vicinity of Maury Island. The Proposed Action is not expected to significantly alter such use because of the infrequency of that use, the whales' demonstrated tolerance to disturbance, and, as mentioned previously, the overall environmental context of Puget Sound. In spring 1999, a gray whale spent two days along the Seattle waterfront, where intense industrial and shipping activities occur. While such use may be the result of "desperate" individuals in search for food, the whale appeared to be unaffected by the activities.

6.3.7.2 Alternatives 1 and 2

For the reasons outlined above, Alternatives 1 and 2 would have no significant effect on salmon, marine mammals, or their habitat.

6.3.7.3 No-Action

Since no activities would occur along the shoreline, the No-Action Alternative would have no effect on salmon, marine mammals, or their habitat.

6.3.8 How would dock repairs and/or maintenance impact marine habitats?

6.3.8.1 Proposed Action

The state of the existing dock and the impact to the marine environment has been a complicated issue and the focus of much public comment and subsequent analysis and discussion from the EIS Team. The dock involves several interrelated issues, including impacts associated with design, construction, maintenance, and operation. To address these concerns, King County has modified and supplemented the analysis in this section.

As proposed, the existing structure would be used to the fullest extent possible. In the DEIS, the analysis assumed about 30 percent of the pilings and 25 percent of the decking and superstructure would require replacement based on a dock assessment done by General Contractors Inc. Additional studies conducted by Symonds Consulting Engineers Inc. on behalf of King County are included as Appendix F and indicate that at least 15 percent of the pilings would need immediate replacement and the remaining pilings would need to be replaced over the next 5 to 15 years. Most of the decking and superstructure would require replacement due to considerable decay.

Design. Under the Proposed Action, the existing design would remain essentially unchanged. The dock design can be divided into two components: pilings and decking/superstructure.

The design specifications for pilings can affect the amount of shading, the level of creosote contamination, the type and amount of "reef" habitat provided, and the surface area of marine sediments occupied by pilings.

Under the Proposed Action, reef habitat and shading provided by pilings would remain about the same, although some reef habitat would be temporarily impacted, as pilings with established communities are replaced with "clean" pilings.

Existing pilings are treated with creosote and are therefore a continuous source of creosote contamination. Under the Proposed Action, long-term creosote contamination would be reduced, as existing laws prohibit the use of creosote-treated pilings. Creosote contamination would increase temporarily during removal of pilings, as creosote that may have accumulated at the base of the pilings would be exposed and agitated during removal.

The design specifications for decking affect shading as well as spill potential. As proposed, the existing solid decking would be replaced. Shading would increase about 10 percent due to replacement of missing decking. Placement of the Applicant-proposed spill tray would also increase the amount of shading, although the height of the conveyor and spill trays would diffuse the shading caused by these structures.

The type of decking structure also affects incidental spilling. Using solid (wood) decking, as proposed, would form a barrier for spills occurring over decked areas.

Construction/Repair. During dock construction and repair, marine habitat would be impacted by (1) pile removal and replacement and (2) the operation of the derrick (the barge-like vessel containing the pile-driving equipment). Both of these can impact marine habitat by direct disturbance and by stirring up sediments (turbidity).

Direct Disturbance. Pile removal and replacement would disturb the areas within approximately 5 feet of pilings. Existing, well-sorted sediment layers that currently support stable biological communities would be disrupted. The mud from a few feet below the current surface contains naturally occurring sulfides and other materials that are toxic to organisms that live near the surface.

This disturbance would affect mostly common species, such as worms, small clams, and other invertebrates. The key concern with this project is the eelgrass bed located near the end of the dock. In studies of Washington State Ferry Terminals, Simenstad et al. (1997) suggested that disturbed areas become unsuitable for eelgrass for 10 years or more. Therefore, replacement of pilings could reduce much of the 20- by 20-foot section of eelgrass growing near the end of the dock.

Operation of the derrick would disturb sediments due to anchoring and, potentially, during resting on the bottom during low tides. Anchoring would mix sediments and reduce biological communities in a manner similar to pile removal and replacement.

In shallower areas, the derrick may rest on the bottom during low tides. This would temporarily reduce populations of marine invertebrates and plants in these areas. If the derrick were to rest on eelgrass beds, then shading and physical damage could occur. Depending on the extent of the damage, impacts may be long-term, since eelgrass is known to be sensitive to physical disturbance.

Turbidity. Repairs and maintenance would stir up sediments, causing clouds of fine material to drift and settle near areas of activity. This increase in turbidity (the amount of solids suspended in the water column) could reduce light and/or bury organisms when the sediments settle.

However, turbidity is not expected to eliminate marine habitats or significantly affect their functioning because:

- The impact would be short-term (limited to a 2-month period). Studies have should that light reduction typically takes 1 to 2 weeks to cause eelgrass loss (Simenstad et. al. 1997). Active pile driving and removal would proceed around the site incrementally and would not exceed 1 to 2 days at any given location.

- A relatively low volume of sediments would be generated. The area immediately adjacent to the dock and down current would become cloudy, but measurable deposits of sediments would be limited to within approximately 10 feet of operations.

- Tidal and other currents would quickly disperse sediments. Based on a study conducted at a similar site (1.9 miles northeast), currents at the site move from south to north and average around 30 feet per minute (0.34 mph) (FishPro 1989). Turbidity would decrease with distance.

- Turbidity is a natural occurrence along the shorelines of Puget Sound (e.g., rivers and other runoff commonly create turbidity, especially during rainy periods).

Increased turbidity would not adversely affect salmon and other fish, as discussed in Section 6.3.4.

Maintenance. In response to public comments, King County has modified and supplemented the analysis of impacts due to dock maintenance. The analysis presented in the DEIS did not detail the effects of long-term maintenance that would be required should about 70 percent of the existing structure be kept (this was the assumption used in the DEIS).

The Applicant wishes to make only the repairs necessary to make the dock functional. Using this approach, much of the dock would be 20 years old or older and would therefore require replacement relatively soon. Pilings that may be adequate now could require replacement in only a few years.

Therefore, as proposed, impacts of maintenance may continue for several years, as existing pilings become old and require replacement.

The type of impacts that would occur are the same as described under dock construction and repairs, including direct disturbance and increased turbidity. As discussed under construction/repairs, direct disturbance would have the greatest effect on the marine environment. Turbidity would cause only temporary and minimal effects.

Operation. The Applicant proposes to operate the facility in essentially the same manner as occurred during previous operations in the 1970s.

A tug would be used to move barges underneath the conveyer to evenly distribute sand and gravel. As described in Section 6.3.4, this would create turbulence (prop wash) on the seaward side of the dock, potentially affecting marine habitat, including the “reef” habitat provided by the sunken barges in the area.

Spill trays used to capture material from the conveyor would be cleaned manually. As stated in Section 6.3.2, manual cleaning would cause some incidental spillage.

As such, operation of the facility would result in the loss of a portion of “reef” habitat provided by one of the sunken barges. Additionally, spillage during spill tray cleaning would temporarily affect small localized areas under the spill tray but would not be expected to have wider reaching or long-term impacts.

6.3.8.2 Alternatives 1 and 2

The potential for temporarily increased turbidity would be the same as under the Proposed Action, since the same dock repairs would be required.

6.3.8.3 No-Action

Under the No-Action Alternative, no dock repairs would be required and there would be no temporary increase in turbidity.

6.3.9 <u>New Section:</u> How would artificial light from the project affect marine life?

6.3.9.1 Proposed Action

Agency and public comments indicated concern about the effects of light, from loading and barging activities, on marine life near the dock. A review of the available scientific literature was conducted to determine the magnitude of such effects. Based on this review it is unlikely that light would have significant effects on marine life in the project area.

Light from the project may attract or repel marine organisms. Light attracts many species of fish (including juvenile salmon) and crustaceans (Popper and Carlson 1998). Attempts to repel fish around the turbines in hydroelectric projects using mercury lights or strobe lights have met with limited success (Nemeth and Anderson 1992). Attempts to use light to attract fish away from hydroelectric projects have been equally unsuccessful.

Factors known to affect fish response to light include age, physiological condition, motivation, and light intensity (Anderson 1988). Puckett and Anderson (1988) showed that juvenile chinook salmon were attracted to light.

Overall, the effects of light on marine organisms vary dramatically depending on the time of day, the intensity of the stimulus, and the species (Popper and Carlson 1998). Attraction to light could have negative and/or positive effects on the species influenced. Species could expect to find increased prey abundance or potentially increased predator abundance.

Tug boat lights may also attract certain species. Lights on tug boats are typically directed forward or towards the rear of the vessel and not directly into the water. The majority of this light is reflected off the surface of the water. Significant attraction of juvenile salmon is not expected because the salmon migrate close to the shoreline**,** whereas tugs and associated lighting would be located waterward of the end of the dock and the dolphins about 250 feet from the shoreline.

6.4 Adverse Impacts and Mitigation

6.4.1 Significance Criteria

King County considers the following as indicators of significance for impacts on marine habitats and fisheries under SEPA.

- Causing an unmitigated adverse impact on
  1. Federal- or state-listed endangered or threatened species; or
  2. Habitat for federal- or state-listed endangered or threatened species, including any designated critical habitat.

Additionally consideration is given to habitat for candidate species listed by the WDFW as well as species of local importance and Fish and Wildlife Habitat Conservation Areas designated in the King County Comprehensive Plan.

Significant habitats, for some species, are those areas with habitat characteristics that may be limited during some time of year or stage of the species life cycle. Therefore mere presence is not always considered significant and King County has chosen to focus habitat protection on lands where the species are likely to be most successful.

Table 6-4 lists Federal and State threatened and endangered species, species of local importance, and fish and wildlife habitat conservation areas that occur within or near the project area.

6.4.2 Measures Already Proposed by the Applicant or Required by Regulation

a. Dock repairs would follow the requirements for new dock construction, as outlined in Table 6-5, and other WDFW requirements to protect eelgrass and other elements of the marine environment (per WAC 220-110 Hydraulic Code Rules).

b. To protect against sand and gravel spilling from the conveyor belt into the intertidal and subtidal marine environment, a spill tray would be fitted below the conveyor belt from the beach out to the discharge end. The tray would be checked and maintained on a regular schedule.

c. The conveyor belt would be equipped with an automatic power interrupt switch, which would engage if no barge were in place to accept the material.

d. All tugs and other potential sources of petroleum product spills would be equipped with emergency spill response and clean-up equipment.

e. A spill response and containment plan for site mining activity would be prepared.

f. Prior to construction, the WDFW would require a marine monitoring and mitigation plan. Per WDFW requirements, the plan would (a) establish a baseline of eelgrass coverage and density; (b) document that the project results in no loss of eelgrass; (c) document that the project results in no significant deposition of sediment in the conveyor/dock vicinity; and (d) provide contingency plans if it appears that the project does result in sediment deposition or a measurable loss of eelgrass coverage or density.

   Construction and repair activities, including pile driving, would be timed to avoid salmon migration and/or herring, surf smelt, and sand lance spawning. Current construction avoidance windows in saltwater areas are generally from June 15 to September 30 of any given year (per WAC 220-110-271). Specific construction avoidance windows may be refined based on consultations with King County and other regulatory agencies (e.g., WDFW, WDNR, and the U.S. Army Corps of Engineers).

6.4.3 Remaining Adverse Impacts and Additional Measures

6.4.3.1 Marine Impact 1 – Disturbance Caused by Dock Repairs and Design-Related Impacts (Shade/Materials)

Specific Adverse Environmental Impact. Marine communities would be physically disturbed during removal and replacement of pilings and anchoring (and potential grounding during low tides) of the derrick when working on the dock stem (the portion of the dock that runs from the shore to the mooring structure).

Based on additional structural analysis, much of the dock superstructure (decking, stringers, and all other features besides pilings) would need to be replaced. Several parts are missing, and much of what remains is untreated wood that has rotted. The welded steel structure of the conveyor is also in disrepair and would require extensive welding and retrofitting. In addition, at least 15 percent of the pilings would need to be replaced immediately and remaining pilings would need to be replaced within 5 to 15 years.

A trade off exists between initial, one-time impacts of repairs and long-term impacts of maintenance. In other words, the more extensive initial repairs and associated disturbances are, the lower the long-term maintenance requirements and thus the associated impacts would be. If only minimum repairs are performed, as proposed, then impacts from maintenance could continue for several years.

Another consideration is that dock design specifications have changed considerably since the dock was constructed. Creosote pilings are no longer acceptable, and most docks are now constructed using concrete and/or steel pilings. This presents a problem with repairs at the dock, because concrete and steel pilings do not fit in well with wood pilings. Fastening steel and concrete to existing wood structures would be difficult and expensive. While wood pilings using non-creosote preservatives are available, such pilings are not as durable as concrete or steel and would require replacement much more frequently.

In addition, grating and other design features are used to reduce shade, and using steel or concrete pilings can reduce the total number of pilings in half.

The mitigation strategies outlined below define specific performance standards for the dock, using the latest design recommendations and requirements to protect the marine environment, as well as measures to mitigate the impact of ongoing repairs.

Dock design, construction, repair, and maintenance will be subject to many permits and legal requirements other than SEPA. Because of this, some mitigation measures may not be acceptable or may require variances under other permits. Therefore, the EIS Team developed three options to mitigate adverse impacts associated with dock design, repair, and construction.

6.4.3.2 Marine Mitigation 1 – Option A: Dock Replacement and Extension

The following specifications would minimize long-term impacts on the marine environment at the site, including shading, creosote contamination, and ongoing disturbance due to maintenance needs. These specifications were developed based on estimated repair needs and on the latest design specifications being considered under King County code, WDFW recommendations, and the Shoreline Management Act.

King County anticipates that these measures would be further defined through required WDFW, WDNR, NMFS, and U.S. Army Corps of Engineers approvals.

a. Replace the existing dock to meet the latest design and materials standards. This would reduce impacts associated with repeated maintenance. Require all pilings and structures to be sufficiently sound to have an expected life of at least 15 years. This measure would also reduce ongoing leaching of creosote into the waters at the site. In addition, extend the dock up to 50 feet so that tugs and barges would be in deeper water. This would eliminate most concerns regarding shading and propwash in the nearshore area. In addition, this would reduce disturbances on the bottom underneath the barges, since the barges and tugs would not be so close to the bottom.

b. To avoid impacts associated with creosote-treated timbers, use pilings recommended by the WDFW and/or WDNR. Current recommendations are for steel or concrete pilings. Prohibit use of toxic materials to construct, repair, maintain, paint, or preserve the structure (per KCC 25-16-120).

c. To reduce shading, design the superstructure (all elements besides pilings) to allow as much light as possible to pass through. Place special emphasis to allow light to pass through on and around where eelgrass is currently growing. Require replacement materials on any surface shading the water to use prisms or be otherwise designed to allow at least 50 percent of incident light to penetrate to the water surface (per KCC 25-16-120). Minimize (a) shading of waters between 3 and 13 feet deep and (b) placement of pilings in waters between 3 and 13 feet deep (per KCC 25-16-120).

d. Construct minimum structure necessary for the intended function (per KCC 25-16-120).

e. Include a spill recovery system, as identified under Marine Impact 5.

f. Include a haul-back system, as identified under Marine Impact 4.

g. Prior to construction, measure the existing eelgrass patch located adjacent to the dock (30 feet from the end) and place markers to avoid physical damage.

h. Install protective covering to minimize dock lighting of the water below the dock.

i. Require "vibratory extraction" to minimize turbidity and sediment disturbance during pile removal.

j. Time construction and repair activities, including pile driving, to avoid periods of herring, surf smelt, and sand lance spawning and salmon migration during any given year, as determined by King County (in consultation with the WDFW and WDNR).

k. Require an independent environmental monitor (or monitors) to be present during all construction activities to ensure mitigation procedures are followed.

The initial disturbance of making these repairs would be greater than if only minimal repairs were made. However, King County has determined that the additional disturbance caused by replacing the dock would nevertheless result in a lower environmental impact because:

1. Impacts related to maintenance over the life of the project would be much lower,

2. The latest design standards would provide long-term mitigation for impacts related to shading, creosote, and maintenance, and

3. Better spill prevention and containment can be installed as part of the new design.

Compensatory habitat enhancement, as defined under Marine Impact 3, would serve to offset this impact over time.

6.4.3.3 Marine Mitigation 1 – Option B: Dock Replacement

As an alternative to extending the dock, the dock could still be replaced, but without an extension.

This would still provide the environmental benefit of (a) reducing the number of times construction would have to occur in the nearshore area; (b) eliminating creosote pilings; and (c) reducing the footprint and shading through new designs and materials.

6.4.3.4 Marine Mitigation 1 – Option C: Dock Repair

The dock could be repaired and still be improved to reduce environmental impacts. This would still leave treated pilings at the site and would reduce the flexibility to design features to protect the environment.

As an option to complete replacement, replacing only the stem of the dock would achieve many of the benefits of complete dock replacement, since the primary area of concern is the area closest to shore. Most of the design features listed in Option A could still be applied to the dock stem portion.

Regulatory/Policy Basis for Condition. King County protects shorelines under the authority and requirements of several formally designated policies, plans, rules and regulations.

Under the King County Shoreline Management Master Program (KCC Title 25), the shoreline on the project site is designated as a "Conservancy Environment." Under this designation, King County can place conditions on otherwise legal actions to protect, conserve, and manage existing natural resources within such shorelines.

The shoreline at the site also meets King County's definition of a Fish and Wildlife Conservation Area. The following features present at the site are identified and protected under King County policy NE-604 as Fish and Wildlife Habitat Conservation Areas:

- habitat for federal or state listed Endangered or Threatened Species (specifically Puget Sound chinook salmon at this site);
- habitat for Salmon of Local Importance (other species of salmon);
- kelp and eelgrass beds; and

- herring and smelt spawning areas (potentially present, although not identified in Puget Sound area inventories).

Under King County Policy NE 602:

fish and wildlife should be maintained through conservation and enhancement of terrestrial, air, and aquatic habitats

In addition, the recent listing of Puget Sound chinook salmon as threatened provides King County with the authority and responsibility to consider additional conditions on proposals necessary to protect salmon habitat. The use of SEPA substantive authority is consistent with existing County policies and can be accomplished within the general framework of permit review.

Finally, King County Policy NE-603 states that:

Habitats for species which have been identified as endangered, threatened, or sensitive by the state or federal government shall not be reduced and should be preserved. In the Rural Area and Natural Resource Lands, habitats for "candidate" priority species identified by the County, as well as species identified as endangered, threatened, or sensitive by the state or federal government shall not be reduced and should be preserved.

6.4.3.5 Marine Impact 2 – Reduced Eelgrass Productivity Due to Shading and/or Physical Impacts from Barges and Tugs

Specific Adverse Environmental Impact. Eelgrass could be reduced in the following areas due to shading by or physical contact with tugs and barges:

- all areas between the shoreline and existing dolphins,
- the shallow shelf located approximately 300 feet north of the dock (transect N7 in Figure 6-2a), and
- the shallow shelf located approximately 200 feet south of the dock (transect S6 in Figure 6-2a).

In addition, the eelgrass bed located near the end of the dock could be physically damaged and/or reduced due to pile removal and/or replacement.

See Marine Impact 4 for the potential for this and other eelgrass patches to be disturbed by propwash.

6.4.3.6 Marine Mitigation 2

The following measures would mitigate impacts associated with the shading of eelgrass:

a. Define and clearly mark as sensitive areas "off-limit" to barges and tugs, including:

   - all areas between the shoreline and existing dolphins,

   - the shallow shelf located approximately 300 feet north of the dock (transect N7 in Figure 6-2a), and

   - the shallow shelf located approximately 200 feet south of the dock (transect S6 in Figure 6-2a).

b. Prohibit tugs and barges from tying up or otherwise being present along the dolphins. Allow only one barge at the site at one time.

c. To offset uncertainty regarding potential impacts to eelgrass due to this impact, as well as from propwash, spilling, and other mechanisms, create an eelgrass mitigation area covering an area of approximately 1,000 square feet. (A greater area may be specified by the WDFW.) Similar eelgrass mitigation has been successfully used for other projects to mitigate direct removal of eelgrass, so King County considers this measure to be technically and economically feasible, as well as effective in mitigating impacts on eelgrass. Design and performance standards would be developed under review and approval of King County. The U.S. Army Corps of Engineers, WDNR, and WDFW have jurisdiction to require additional mitigation under their regulatory authority separate from SEPA.

d. Require mitigation plans to contain elements required by WDFW for marine habitat mitigation, including:

   1. baseline data;

   2. estimate of impacts;

   3. mitigation measures;

   4. goals and objectives;

   5. detailed implementation plan;

   6. adequate replacement ratio;

7. performance standards to measure whether goals are being reached;

8. maps and drawings of proposal;

9. as-built drawings;

10. operation and maintenance plans (including who will perform);

11. monitoring and evaluation plans (including schedules);

12. contingency plans, including corrective actions that would be taken if mitigation developments do not meet goals and objectives; and

13. any agreements on performance bonds or other guarantees that the Applicant would fulfill the mitigation, operation and maintenance, monitoring, and contingency plans.

Protection of eelgrass through avoidance and establishment of a planted eelgrass patch would effectively minimize and/or compensate shading from barges and/or tugs resulting in no net loss of eelgrass presence and/or function, although a temporary net loss would occur due to the time it takes for mitigation sites to develop.

Regulatory/Policy Basis for Condition. Same as described under Marine Impact 1.

6.4.3.7 Marine Impact 3. Reduced Marine Life (Other than Eelgrass) Due to Shading, Noise, Vibration, and Visual Disturbance from Barges and Tugs

Specific Adverse Environmental Impact. Marine invertebrates and macroalgae would be reduced and, in some cases, eliminated along approximately 500 feet of the nearshore subtidal zone that would be shaded from barges (and otherwise impacted by noise and physical disturbance). Additional reductions could occur along dolphins and other nearshore areas at the site.

Loading and barging would create unavoidable noise and disturbance to the area immediately surrounding the dock. This area currently supports marine life associated with underwater structures. This marine life includes sensitive species, such as cod and rockfish, that are WDFW “candidate” species and are also under review by NMFS for listing under the Endangered Species Act.

6.4.3.8 Marine Mitigation 3

a. Restrict barge docking to one barge at any one time (as defined under Marine Impact 2) to reduce the effect of shading during barge loading.

b. Compensate for habitat lost due to shading and disturbance by replacing, enhancing, or providing substitute resources or environments, per WAC 197-11-768.

   Habitat compensation could be in the form of substrate enhancements (e.g., placement of cobbles), creation of artificial reef habitat, riparian/shoreline enhancement, and/or other enhancements that would benefit the marine environment. Specific measures are not proposed at this time, but would be defined in conjunction with other permitting for the project under the Shoreline Management Act, and through applicable regulatory agencies, including the U.S. Army Corps of Engineers, WDFW, and WDNR. With major habitat restoration efforts being undertaken throughout the region, effective mitigation could be developed that is reasonable and technically feasible of accomplishing mitigation objectives. Habitat enhancement should be located as close to the impacted area as possible, and be restricted to the southeastern shoreline of Maury Island.

Regulatory/Policy Basis for Condition. Same as described under Marine Impact 1.

6.4.3.9 Marine Impact 4 - Propwash

Specific Adverse Environmental Impact. Without restrictions, tugs could direct propwash toward shore and scour the bottom, potentially eliminating eelgrass and other marine organisms.

In addition, during low tides, a fully loaded 10,000-ton barge could physically damage the bottom around the end of the dock.

6.4.3.10 Marine Mitigation 4

a. Establish Approach and Departure Protocol: The following restrictions are based on the EIS Team’s interviews of tug operators and review of similar restrictions placed at other facilities. Clear approach and departure rules have been used successfully at other docking facilities to avoid impacts to the marine environment. Presented below are preliminary restrictions to mitigate impacts from tug operations. These restrictions would be further refined during final project design conducted as part of final permit specifications.

1. Prohibit fully loaded 10,000-ton barges to be at the dock during negative tides (tides lower than MLLW) to ensure adequate separation from the barge and the bottom.

2. Require tugs to "back" the barge away from the dock to minimize propwash. By backing away from the dock, the tug is located in deeper water on the waterward side of the barge and prop wash bottom interaction is reduced. In addition, the majority of the prop wash would be dissipated by the barge, which has a deeper draft. Specific exemptions may be defined for conditions that may render this technique impractical or unsafe (e.g., certain winds, tides, or currents).

3. Under conditions that may render "backing" impractical or unsafe, the use of a "standing spring line" and proper fendering of the dolphins could be required to facilitate departure utilizing low-thrust maneuvering. A standing spring line is a rope that uses tension to swing the barge away from the dock and reduce the need for propeller thrust.

4. Define and require a very slow approach and departure speed to reduce propwash velocity and intensity (and shading due to air bubbles).

5. Prohibit tugs from directing propwash toward the shore except where absolutely necessary. Define when it may be necessary to direct propwash toward the shore and establish maximum throttle limits for such situations.

6. Require tug operators to be trained, tested, and certified in the approach and departure protocol. Require annual recertification.

b. Establish a "haul back system" to be used to position the barge during loading. The Applicant proposes to use tugs to move barges back and forth under the conveyor to distribute the load. This would increase the use of tugs and associated potential for propwash impacts. By establishing a haul back system—a system of cables and pulleys to position the barge along the dock—propwash associated with the loading procedure could be eliminated.

Establishment of a planted eelgrass patch (defined under Marine Impact 2) and compensatory habitat enhancement (defined under Marine Impact 3) would further serve to offset the likelihood of a significant loss of habitat due to propwash.

Regulatory/Policy Basis for Condition. Same as described under Marine Impact 1.

6.4.3.11 Marine Impact 5 – Spilling

Specific Adverse Environmental Impact. Sand and gravel would accumulate below the loading area and/or along the conveyor, eliminating most plants and animals living on and within the sea floor in these areas.

6.4.3.12 Marine Mitigation 5

The following measures would reduce spillage from the conveyor belt:

a. Install a windscreen on the portion of the conveyor that passes over water to eliminate wind-blown spillage. Require King County approval and engineer-prepared plans to assure that the screen would prevent wind from blowing materials off the conveyor.

b. Prohibit the use of a movable boom at the Maury Island site. Such a boom increases the likelihood of spillage due to human error.

c. Require the discharge end of the conveyor to be equipped with a "downspout." A downspout would reduce spillage by reducing the distance over which the sand and gravel is exposed to wind before landing on the barge.

d. Restrict barge loading to 80 percent maximum capacity to allow more space between the load and the sides of the barge and to prevent overloading. Specific measures would need to be established to define and monitor limits.

e. Establish video monitoring of loading operations to identify spillage or potential spillage and revise management procedures accordingly.

f. Conduct quarterly dive surveys to identify spills for the first year, and annual dives thereafter if spilling is found to be limited to the spill impact area immediately below the dock.

g. Prohibit any washing or sweeping of spilled materials from the dock into the water.

h. Establish a clear protocol to prevent spillage during cleaning of spill trays. An automatic recovery system could be designed to return collected materials to the shore via a reverse conveyor system. Hand clearing may be less effective.

While some spillage would be inevitable, the impacts would be limited to small areas immediately adjacent to the existing loading area, which is small and which consists of previously spilled materials. Compensatory habitat enhancement, as defined under Marine Impact 3, would serve to offset this impact over time.

Regulatory/Policy Basis for Condition. Same as described under Marine Impact 1.

6.4.3.13 Marine Impact 6 – Geoduck Harvest

Operation of the facility could interfere with Tribal and/or State geoduck harvesting.

6.4.3.14 Marine Mitigation 6

Require an access agreement among the Applicant, the WDNR, and the Puyallup Tribes to prevent interference with geoduck harvest.

Regulatory/Policy Basis for Condition. Same as described under Marine Impact 1. Commercial shellfish areas are specifically protected under NE-604, Fish and Wildlife Conservation Areas.

6.4.3.15 Marine Impact 7 – Potential Adverse Effects on Puget Sound Chinook Salmon

Specific Adverse Environmental Impact. Individual Puget Sound chinook salmon could be impacted by habitat changes, including changes in eelgrass (see Marine Impact 1), changes in predation factors, and changes in behavior.

Young salmon use eelgrass for foraging and for hiding cover. Without additional mitigation, the Proposed Action could reduce eelgrass from propwash, shading, and dock construction and repair.

Changes in predation could occur should dock structures and the associated underwater habitat change due to repairs. Dock structures are known to support predators of salmon.

Minor changes in behavior of migrating juvenile salmon could occur due to vibration, noise, and visual disturbances related to mining at the site. Such changes could conceivably reduce the survivability of individuals, but would not affect Puget Sound salmon at the population or species level. Impacts would be limited to the site boundaries.

6.4.3.16 Marine Mitigation 7

a. To ensure no net loss of habitat, restore the riparian zone by replanting forest with native vegetation and stabilizing soils within 300 feet of the shoreline. Follow WDNR recommendations for shoreline management.

b. Implement design considerations per King County policies and guidelines, as revised in response to the listing of Puget Sound chinook salmon (using the latest working draft and/or staff recommendations, should the revised guidelines not be completed before the project starts).

Individual chinook salmon may be adversely affected by behavior modification. Timing restrictions would eliminate concerns about dock repairs/construction impacts on juvenile migration. Riparian habitat enhancements, together with eelgrass mitigation (Marine Mitigation 2), would result in no net loss of salmon habitat.

Regulatory/Policy Basis for Condition. Same as described under Marine Impact 1, in particular, King County's authority and responsibility to condition projects to protect listed species.

6.4.3.17 Marine Impact 8 – Potential for Adverse Effects on Forage Fish (Herring, Surf Smelt, and Sand Lance)

Specific Adverse Environmental Impact. As with Puget Sound chinook salmon, the project would alter current habitat of herring, including changes in eelgrass, changes in substrate (the mud, sand, and other materials on the bottom), and noise/vibration/ visual disturbances.

As described in Section 6.3, significant impacts on surf smelt and sand lance are not expected, since these species spawn high up on the shoreline.

The scientific evidence is not sufficient to accurately predict if herring spawning would be affected by the project. Since the project site is outside of the core herring spawning area, potential disturbance to spawning would be most likely to occur during high population levels, when “spill over” from the main spawning grounds occur.

The impact would be limited to the site, and would not be expected to eliminate spawning, since herring, as with most other fish that spawn communally, are highly motivated to spawn, and less likely to be frightened by noise. The biggest concern would be loss of habitat, since with lower habitat values, herring would either not spawn in this area, or would continue to spawn with lower survival of eggs.

This critical role of habitat prompts the consideration of mitigation measures to minimize losses of eelgrass, as described above under Marine Impact 2.

6.4.3.18 Marine Mitigation 8

Establish additional eelgrass, as described under Marine Impact 2.

Regulatory/Policy Basis for Condition. Same as described under Marine Impact 1.

6.5 Cumulative Impacts

SEPA requires that EISs evaluate and disclose cumulative impacts, and provides the following guidance on how to factor cumulative impacts into decisions regarding impacts and mitigation (WAC 197-11-060):

The range of impacts to be analyzed in an EIS (direct, indirect, and cumulative impacts, WAC 197-11-792) may be wider than the impacts for which mitigation measures are required of applicants (WAC 197-11-660). This will depend upon the specific impacts, the extent to which the adverse impacts are attributable to the applicant's proposal, and the capability of applicants or agencies to control the impacts in each situation.

Impacts to salmon and the marine environment are a good example of how many apparently small actions can combine to cause major environmental effects. People have developed about one-third of the shorelines of Puget Sound. Much of this development is in the highly populated King County, where about half the shoreline is developed.

This past development has, in part, contributed to the decline in marine organisms, including salmon, rockfish, eelgrass, and herring. Other causes, including logging, dams, urban and suburban development, fishing, pollution, and even changes in ocean currents and upwelling, have aggravated these declines. No one factor "caused" the declines. But together they have worked to threaten salmon and other species with extinction.

The proposed mine at Maury Island would not, in itself, tip the scales one way or another regarding the continued existence of salmon or other marine species. However, any impacts on the marine environment must be looked at in light of the extensive impacts that have already occurred. This cumulative aspect of the anticipated impacts contributed to the extensive analysis and mitigation presented in this chapter. While the project would affect elements at the scale of the site and individuals, rather than at regional or population levels, these impacts are increased in significance due to the numerous, wide-ranging actions that have occurred in the past.

6.6 Significant Unavoidable Adverse Impacts

The project objectives cannot be achieved without some adverse effects on the marine environment. While these impacts could be greatly offset through avoidance and compensation (as described in Section 6.4), noise, spillage, shading, and physical impacts would be expected during the active mining operation. Most of these impacts would occur for as long at the project operates. Subsequent to cessation of mining, the shoreline is expected to recover. The current condition of the site shows that this area can recover from relatively extensive damages. Past mining occurred with little or no consideration of the environment, and now the site is considered a good example of a healthy, functioning shoreline.

SEPA, WAC 197-11-330 (threshold determination), provides some guidance regarding significance, directing agencies to consider whether:

A project may, to a significant degree: … Adversely affect environmentally sensitive or special areas, such as loss or destruction of historic, scientific, and cultural resources, parks, prime farmlands, wetlands, wild and scenic rivers, or wilderness;

The shoreline at the site is an environmentally sensitive and special area, and, as discussed in Section 6.4, some disturbance to the shoreline and associated biotic communities would be unavoidable. Dock construction would disturb marine sediments and operations would shade the marine environment and produce noise and vibration that may cause fish to avoid the area.

The severity of these impacts cannot be fully predicted, simply because so many variables are involved and because we do not have absolute knowledge about marine ecosystems. Where uncertainty exists, additional mitigation measures have been developed for consideration as precautionary measures. Such a precautionary stance may be appropriate due to the sensitivity of the marine environment; the high degree of public and agency concerns; and the many applicable laws, plans, and policies, including the Endangered Species Act, the Shoreline Management Act, and King County code and policy.

Puget Sound chinook salmon may be startled by noise, vibration, and visual/physical presence created by barge loading operations. Still, salmon are expected to continue to move past the site. The project would not create a barrier to migration. Impacts of operation may alter the behavior of individual salmon.

Any alteration in behavior could conceivably reduce the ability of individuals to feed, breed, or seek shelter, but the actual impact is expected to be "sub-lethal" and may even be negligible. The scientific literature provided little evidence pointing to probable significant adverse impacts. The marine environment is a noisy place and the constant, relatively low level of noise and vibration that would be generated by the project is not the type of stimulus typically found to startle animals of any type. Intense, spontaneous, and irregular noises are the type of noises that are startling.

Impacts on eelgrass could be essentially avoided by extending the dock into deeper water. If the dock were not extended, then two patches of eelgrass could be reduced. The impact can still be mitigated by requiring replacement planting, as is commonly done for areas where eelgrass is removed. Some net loss would probably occur due to the lag time between impact and mitigation. In addition, mitigation is not always effective. The absolute area that could be impacted is in the range of a few hundred square feet. The exact area cannot be predicted precisely, but the patches would probably remain, replacement patches could be established, and other patches may develop naturally over time.

Herring spawning may be reduced within the eelgrass patches present at the site, and noise from the project could conceivably cause herring to avoid the site. The impact may affect individuals, but would not measurably affect herring at the population level, including the Quartermaster Harbor stock (which is considered healthy). The site is not a major spawning area, and in some years, herring probably do not spawn at the site at all. Creation of additional eelgrass habitat, per Marine Impact 2, would compensate for potential impacts to herring over time.

King County will not issue a grading permit until the Applicant obtains all other required county, state, and federal approvals. Most of these approvals focus on the marine environment, and require much more detailed mitigation plans than is required under SEPA. SEPA requires only that the feasibility and effectiveness of mitigation measures be determined (although detailed plans are required prior to project initiation). However, wetland permitting through the U.S. Army Corps of Engineers will require more detailed plans. Likewise, the WDFW will require detailed plans for the dock and associated mitigation measures.

King County will coordinate with these agencies, including the WDFW, WDNR, U.S. Army Corps of Engineers, and National Marine Fisheries Service, to further define mitigation measures. A coordinated effort among the agencies involved would be the preferred way to develop the more specific plans required by these agencies under their regulatory authority.

In summary, several unavoidable adverse impacts on the marine environment are expected. Dock construction would disturb marine sediments and operations would shade and produce noise and vibration that may cause fish to avoid the area. These impacts would be limited to the site of action and could be reduced or compensated for through the many mitigation measures presented in Section 6.4, including revised performance standards for the dock and replacement and/or enhancement of marine habitat near the site.

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Table 6-1. Summary of Marine Habitat Zones Adjacent to the Project Site

Habitat Zone	Slope and Depth	Substrate	Typical Plant and Animal Life
Shoreline	Elevation greater than about +13.4 feet MLLW	Coarse sand with occasional areas of cobble	Sparse
Intertidal Zone	Gentle slope -2.9 to +13.4 feet MLLW	Coarse sand with occasional areas of cobble	Various algae, eelgrass at lower end. Presumably used by juvenile salmon, spawning herring, surf smelt, and sand lance. Limited bivalves and crabs.
Nearshore Subtidal Zone	Gentle to steep slope, -2.9 to -22 feet MLLW	Sand and silt	Patches and beds of eelgrass, various algae including Sargassum, flat fish (e.g., sole, flounder), juvenile salmon (including chinook), and herring (spawning). Some bivalves and crabs.
Offshore Zone	Tidal elevations below -30 feet MLLW	Sand and silt	Bivalve mollusks including geoduck clams, horse clams, cockles dominate. Various starfish species, especially the sunflower-star (*Pycnopodia helianthoides*). Occasional crabs.
Dock	Gentle to steep slope, greater than +4 to -22 feet MLLW	On and adjacent to pilings	A typical piling community. Species observed on the pilings included sea anemones, giant barnacles, green sea urchins, kelp crabs, decorator crabs, nudibranchs, limpets, chitons, mussels, jingle shells, and various red and brown algae. Pile perch, striped seaperch, and rockfish also expected here.
Sunken Boats	Below -30 feet MLLW	Pleasure boat and two wooden barges.	Large numbers of pile perch, striped seaperch, lingcod, and rockfish. At least three masses of lingcod eggs were observed on one of the sunken barges.

Table 6-2. Extent of Eelgrass Habitat at Proposed Project Site

Habitat	Proposed Site			Linear Extent	
	Linear extent [a]	Percentage of Maury	Percentage of Maury/Vashon	Maury Island	Maury/Vashon Island
Total	800 feet	0.89%	0.28%	16.9 miles	52.4 miles
Potential eelgrass [b]	800 feet [b]	1.4% [b]	0.52% [b]	10.6 miles	29.3 miles
Current eelgrass	150 feet [c]	0.26%	0.09%	10.6 miles [d]	29.3 miles [d]
Herring spawning [b]	800 feet [b]	1.7% [b]	0.78% [b]	8.8 miles	19.5 miles

[a] Linear measurements are not meant to be indicative of the actual area of eelgrass habitat but simply to give a general sense of the scale of the Glacier Northwest site.

[b] The use of 800 feet represents the entire site; eelgrass and herring spawning do not currently occur on the entire site.

[c] "Current" eelgrass values for the proposed project site are based on an eelgrass survey conducted in summer 1999 (Jones & Stokes 1999).

[d] The "current" eelgrass values for Maury/Vashon Island are based on the Puget Sound Environmental Atlas (PSEP 1992). More recent eelgrass surveys have not been completed for Maury and Vashon Islands.

Table 6-3. Marine Algae, Plant, and Animal Species Observed Adjacent to the Maury Island Gravel Mine Site

Major Taxa	*Common Name*	*Scientific Name*	*Abundance*	*Notes*
Algae	Diatoms	*Bacillariophyceae*	Common	Common on sand at about –5 feet MLLW
	Kelp	*Laminaria saccharina*	Common	Common at –10 feet to -30 feet MLLW
	Red algae	*Rhodophyta*	Occasional	
	Thin red algae	*Gracilaria* sp.	Occasional	
	Sea lettuce	*Ulva lactuca*	Common	Drift *Ulva* between +5 feet and 0 feet MLLW, attached *Ulva* below 0 feet MLLW
		Enteromorpha sp.	Common	Drift *Enteromorpha* between +5 feet and 0 feet MLLW, attached between 0 feet and –5 feet MLLW
Plants	Eelgrass	*Zostera marina*	Common	In patches and small beds generally between –5 feet and –16 feet MLLW
Hydrozoa (jellyfish)	Lion’s mane jellyfish	*Cyanea* sp.	1	On transect S-3
Anthozoa (anemones)	Plume anemone	*Metridium* sp.	Common	Common on pilings; orange and white varieties
Mollusks	Geoduck clam	*Panopea generosa*	Occasional	Common under the pier; occasionally found elsewhere; found below -15 feet MLLW
	Piddock clam	*Pholadidae*	Occasional	Common under the pier; occasionally found elsewhere; found below -15 feet MLLW
	Heart cockle	*Clinocardium nutalii*	Occasional	
	Bay mussel	*Mytilus edulis*	Common	On pilings
	Octopus	*Octopus* sp.	1	On transect N-8
Worms	Plume worms	*Sabellidae*	Occasional	On pilings
	Tube worms	*Polychaeta*.	Common	In sand at about –2 feet MLLW
Shrimp	Broken-back shrimp	*Crangonidae*	1	On control transect C-1
Crabs	Dungeness crab	*Cancer magister*	Occasional	
	Graceful crab	*Cancer gracilis*	Occasional	In eelgrass beds
	Red rock crab	*Cancer productus*	Few	
	Northern kelp crab	*Pugettia producta*	Occasional	
	Helmet crab	*Telmessus cheiragonus*	Occasional	In control area eelgrass bed, transect C-1
	Hermit crab	*Pagurus* sp.	Occasional	
Barnacles	Acorn barnacle	*Balanus* sp.	Common	On cobbles, boulders, and pilings +10 feet to +5 feet MLLW

Table 6-3. Continued

Major Taxa	Common Name	Scientific Name	Abundance	Notes
Sea Stars	Sunflower star	*Pycnopodia helianthoides*	Common	At depths below –20 feet MLLW
	Sunstar	*Solaster dawsoni*	Common	
	Short-spined sea star	*Pisaster brevispinus*	Occasional	At depths below –20 feet MLLW
	Rose star	*Crossaster pappofus*	1	On transect N-6
	Leather star	*Dermasterias imbricata*	Occasional	At depths below –20 feet MLLW
Fish	Shiner perch	*Cymatogaster aggregata*	Common	Especially common in eelgrass
	Pile perch	*Rhacocheilus vacca*	Common	Near pilings
	Brown rockfish	*Sebastes auriculatus*	Common	Near pilings
	Copper rockfish	*Sebastes caurinus*	Occasional	Near pilings
	English sole	*Parophrys vetulus*	Common	
	C-O sole	*Pleuronichthys stellatus*	Occasional	
	Starry flounder	*Platichthys stellatus*	Occasional	
	Sand dab	*Citharichthys* sp.	Occasional	
	Crescent gunnel	*Pholis laeta*	Common	In eelgrass
	Sand lance	*Ammodytes hexapterus*	Abundant	Large schools
	Tubesnout	*Aulorhynchus flavidus*	Common	
	Cabezon	*Scorpaenichthys marmoratus*	1	
	Buffalo sculpin	*Enophrys bison*	Occasional	
	Sculpin (other unidentified)	Various species	Common	
	Ratfish	*Hydrolagus colliei*	1	On transect N-6
	Chinook salmon	*Oncorhynchus tshawytscha*	Occasional	Age 0+, two on transect S-3, one on C-1, one on C-2
	Snake prickleback	*Lumpenus sagitta*	1	On transect S-5
	Painted greenling	*Oxylebius pictus*	1	
	White-spot greenling	*Hexagrammos stelleri*	2	On transects S-7 and S-9
	Spiny dogfish	*Squalus acanthias*	1	On transect C-2

Table 6-4. Sensitive Marine Species in the Vicinity of the Project Area

Species	Federal Status	State Status	King County Local Importance		Location on Site
			2000 (proposed)	1997 (revisions to 1994 plan)	
Chinook Salmon Puget Sound ESU	Threatened	Candidate	Yes		Juvenile salmon may use nearshore areas during outmigration. Adult salmon are likely to occur in the deeper areas.
Bull Trout	Threatened			Yes	No known use of site; however, bull trout may occasionally visit the site for foraging.
Pacific Herring	Under review[1]	Quartermaster Harbor stock not listed[2]	Yes		Adults and juvenile herring occur at the site. Eelgrass may be used for spawning by overflow from Quartermaster Harbor stock. Main spawning grounds are located in Quartermaster Harbor.
Rockfish[3]	Under review	Candidate	Yes		Several rockfish species occur in "high relief" habitat provided by the structure of the dock and sunken barges.
Pacific Cod, Walleye, Pollock, and Pacific Hake	Under review		Yes		No known use of site; however, Pacific cod may occasionally visit.
Lingcod			Yes		Lingcod occur in "high relief" habitat provided by dock and sunken barges. Lingcod eggs were observed at the site during dive surveys.
Longfin and Surf Smelt			Yes		Smelt occur in shallow areas of the site. Spawning possible along upper intertidal sandy beach (+5 ft MLLW).
Pacific Sandlance			Yes		Sandlance occur in shallow areas of the site. Spawning possible along upper intertidal sandy beach (+5 ft MLLW).
English and Rock Sole			Yes		Sole occur at the site associated with sand/gravel substrate throughout project area.
Commercial and recreational shellfish areas			Yes		No commercial or recreational shellfish beds have been identified that are monitored by the Washington Department of Health. However, collection of shellfish by island residents and visitors occurs.
Kelp and Eelgrass beds			Yes		No bull kelp (*Nereocystis*) occurs at the site, however *Laminaria spp.* is common near the end of the dock. Several patches of eelgrass occur in the project area and larger beds occur to the north and south of the site (See Figures 6-2a and 6-2b.)
Herring, Sandlance, and Smelt spawning areas			Yes		Herring spawning may occur in eelgrass at the site during years of peak abundance of the Quartermaster Harbor stock. Surf smelt and sand lance may spawn in the upper intertidal areas (+5 feet MLLW) along the sandy beach.

Note: Salmonids of local importance that may occur at the project site include chum, coho, and pink salmon; searun cutthroat; and steelhead trout.

[1] Species under review by the National Marine Fisheries Service are not afforded protection under the Endangered Species Act or any state or local regulations.

[2] Pacific herring stocks at Discovery Bay and Cherry Point are State Candidate species but the Quartermaster Harbor stock is considered healthy.

[3] Brown, copper, and quillback rockfish are currently under review by NMFS for listing under the ESA. Brown, copper, greenstriped, widow, yellowtail, quillback, black, china, tiger, bocaccio, canary, redstripe, and yelloweye rockfish are State candidate species. Black, copper, quillback, and yelloweye rockfish are King County species of Local Importance.

Table 6-5. Compliance Analysis of Washington Administrative Code Guidelines Related to Dock Construction

WAC Requirement per Chapter 220-110 WAC HYDRAULIC CODE RULES	***Compliance as Proposed?***	***Additional Mitigation***
Work waterward of the ordinary high water line shall be prohibited or conditioned for the following times: March 15 – June 14.	No.	Require dock repair work to be completed outside of these dates.
(3) Piers, docks, floats, rafts, ramps, boathouses, houseboats, and associated moorings shall be designed and located to avoid shading of eelgrass (*Zostera* spp).	Yes. The major portion of the dock (where barges would be loaded) is located in areas too deep for eelgrass.	
(4) Kelp (Order *Laminariales*) and intertidal wetland vascular plants (except noxious weeds) adversely impacted due to construction of piers, docks, floats, rafts, ramps, boathouses, and houseboats shall be replaced using proven methodology.	No.	Mitigation may be required for potential spillage impacts to kelp located under the barge loading area.
(5) Mitigation measures for piers, docks, floats, rafts, ramps, and associated moorings shall include, but are not limited to, restrictions on structure width and/or incorporation of materials that allow adequate light penetration (i.e., grating) for structures located landward of -10.0 feet MLLW.	Potentially. Compliance would require additional consultation with the WDFW.	The WDFW may require grating to be used where possible to allow additional light penetration along the shoreline.
(6) Piers, docks, floats, rafts, ramps, boathouses, houseboats, and associated moorings shall be designed and located to avoid adverse impacts to Pacific herring spawning beds and rockfish and lingcod settlement and nursery areas.	No. Rockfish and lingcod are present where barges would be loaded. Herring spawning could be affected at the site.	Mitigation may be required to replace or compensate for potential impacts to rockfish, lingcod, and herring habitat.
(7) Piers, docks, floats, rafts, ramps, boathouses, houseboats, and associated moorings shall be designed and located to avoid adverse impacts to juvenile salmonid migration routes and rearing habitats.	Yes. The elevated pier structure with widely spaced pilings allows fish passage.	